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June 10, 1937

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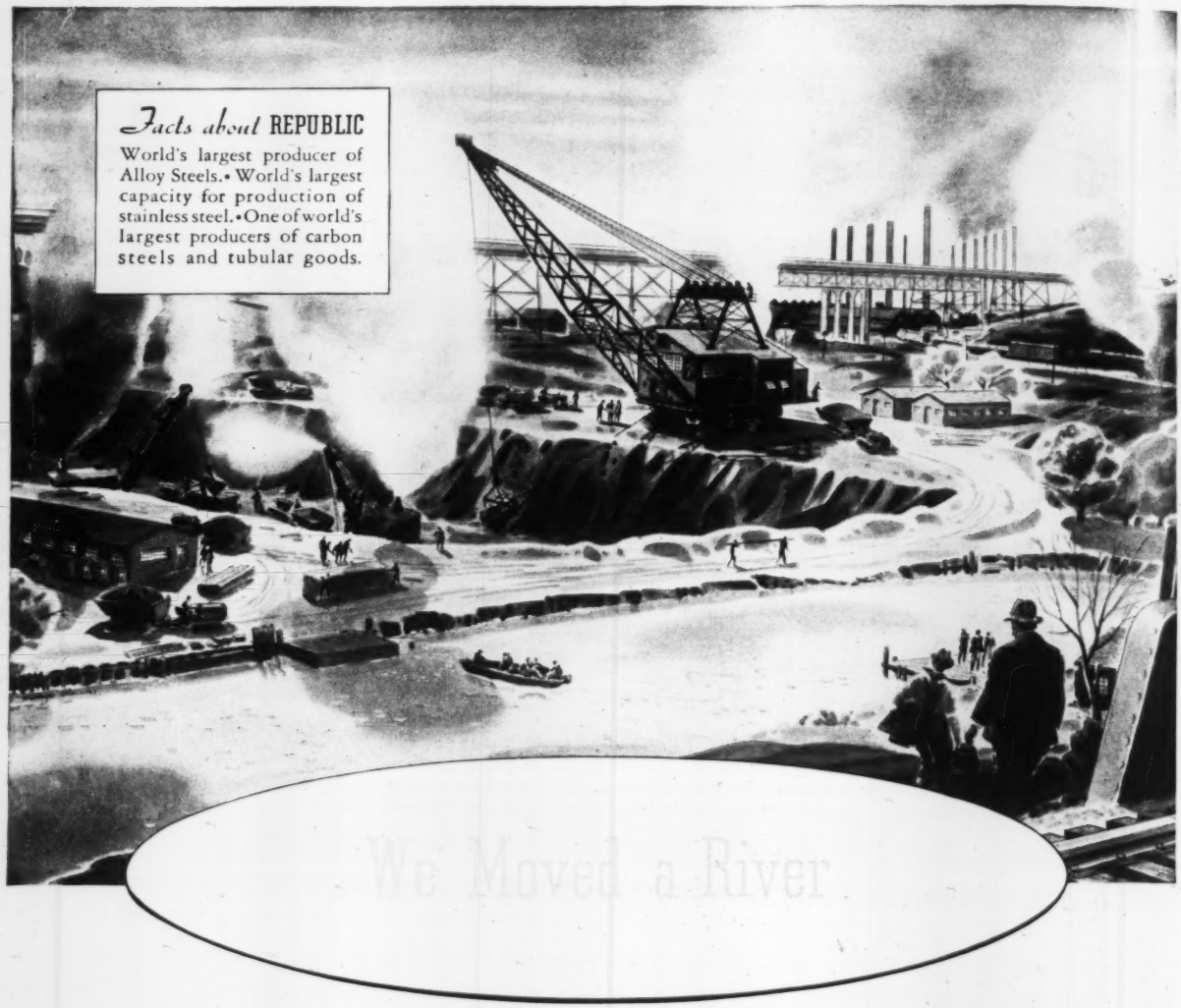
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Concerning Our New Dress

AS FORESHADOWED on this page last week, *Engineering News-Record* here appears in its new dress. The change involves two publishing elements; one is structure, the other is typography.

Most obvious of the changes in structure is that of bringing up front those features that we have found to have the most widespread appeal amongst our readers. Experience indicates that the current news of engineering and construction activities is of most immediate interest to the great majority of our readers. Accordingly we present first the news of the week.

Following this weekly newspaper of the field comes the reader comment and discussion. Here is offered to practicing engineers and constructors an opportunity to express their own thoughts and opinions on matters of general and technical interest. In this section we hope to present every week a quota of lively comment and controversy that will reflect what our readers are thinking about. Next in order and closely related to this, come the editorials, which embody the views of the editorial staff concerning matters that affect the work and well-being of engineers and constructors.

These three sections, in the forefront of each issue, present a comprehensive survey of what has happened during the preceding week together with appropriate discussion, interpretation and comment on the part of both readers and editorial staff.

FOLLOWING this weekly report of spot news and comment appear the technical articles. These, as heretofore, are selected and designed with a view to recording and publishing the best of thought, practice and experience in the various departments of engineering and construction. Naturally some of these articles will deal with fundamental principles or with matters of so general an interest as to have universal appeal. Others, more highly technical, will be of particular interest to those engaged in special departments of the field. It is our purpose to maintain, as always, a sound balance between these two classes of article. In every issue we shall continue to offer a representative group of articles, both of general concern and of more explicit value to those of more specialized interest.

Following these major articles a few more pages of news take care of the overflow from the leading news section. Next come the analysis of unit prices, which we have found to be of wide-spread interest and value. In the first issue of each month this section will be devoted, as heretofore, to the reports of current wage scales and material prices. In the department "New Aids to the Constructor" increased attention is given to the new materials and equipment as information concerning them is made available by their manufacturers.

THE CLOSING PAGES of each issue will be devoted to the weekly Construction Reports. These now are printed on a tinted stock by which they may be readily located by the many readers who follow them so regularly. In the interest of timeliness, this section as well as the current news section will be printed in a last-minute form. It will include, in addition to Construction Reports, the latest official proposals of bids wanted on engineering construction and related work.

It is unnecessary to comment here on typography: type must speak for itself. In our selection of type sizes, style and spacing, in the design of heads and the general arrangement of the pages, we have spared no pains to produce a magazine that will be as clean, as legible and as generally readable as modern typographical skill can make it.

In thus modernizing the physical form of the paper, publishers and editors have done their best to maintain those standards of authority and usefulness that have characterized *Engineering News-Record* throughout its long service to the men of civil engineering and construction. This effort to improve the vehicle is in line with their consistent purpose to make the substance of even greater interest and utility to those to whose service it is dedicated.

Willard Chevalier

· ENGINEERING NEWS-RECORD ·

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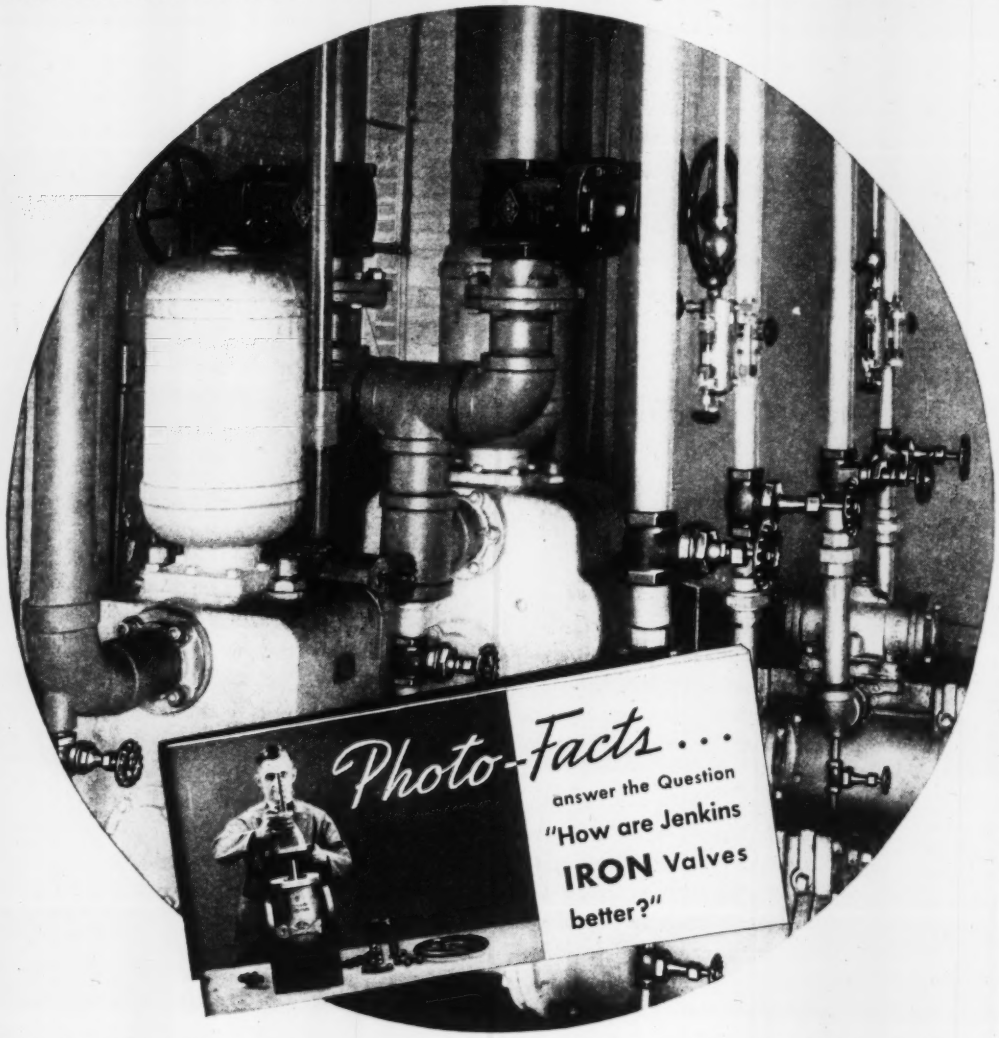
Natural Allies for Economy!

Add Jenkins IRON Valves to the job for lowest costs



LARGER pipe lines are as important as the small ones, on which hundreds of plants and buildings consider it wise to use Jenkins Bronze Valves as standard equipment. For that reason, Jenkins quality is bound to be a good investment. But, there is another reason . . . even stronger . . . why it pays to use "the best" in IRON valves, too.

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F. E. SCHMITT, *Editor* WILLARD CHEVALIER, *Vice-President*

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VOL. 118 *JUNE 10, 1937* No. 23

THIS WEEK AND NEXT

With this issue Engineering News-Record appears in a new form that the editors hope will make it both more useful and more easily read.

Riverfront remodeling and reclamation, a favorite city planning objective, is approaching accomplished fact in New York City on a scale never before equaled. Along seven miles of the Hudson River shoreline north of 72nd St. some $25,000,000 is being spent on a construction program involving an elevated six-lane highway, a parkway, special grade-separation structures, elaborate park structures and the burying of a five-track railroad in a subway structure built above ground (p. 863).

The South is making rapid strides toward improving its sanitary conditions. Many interesting developments are reported as the result of an editor's trip (p. 873).

Wellpoints have been used to advantage on several bridge jobs in Kansas, materially reducing the amount of wet excavation and cofferdamming. The record is valuable because the jobs are typical of many found elsewhere.

The Cuyahoga River at Cleveland has been moved to a new channel to make way for the new plant of the Republic Steel Corp. Bad weather complicated the contractor's job (p. 880).

Low water levels in Montreal harbor and in the St. Lawrence ship channel have brought out many schemes for channel improvement. These projects are the subject of a report that is abstracted on p. 883.

Next week the Lincoln Tunnel, a new traffic artery under the Hudson River at New York, will be outlined in the first of three articles on the project. Subsequent articles will take up the construction operations.

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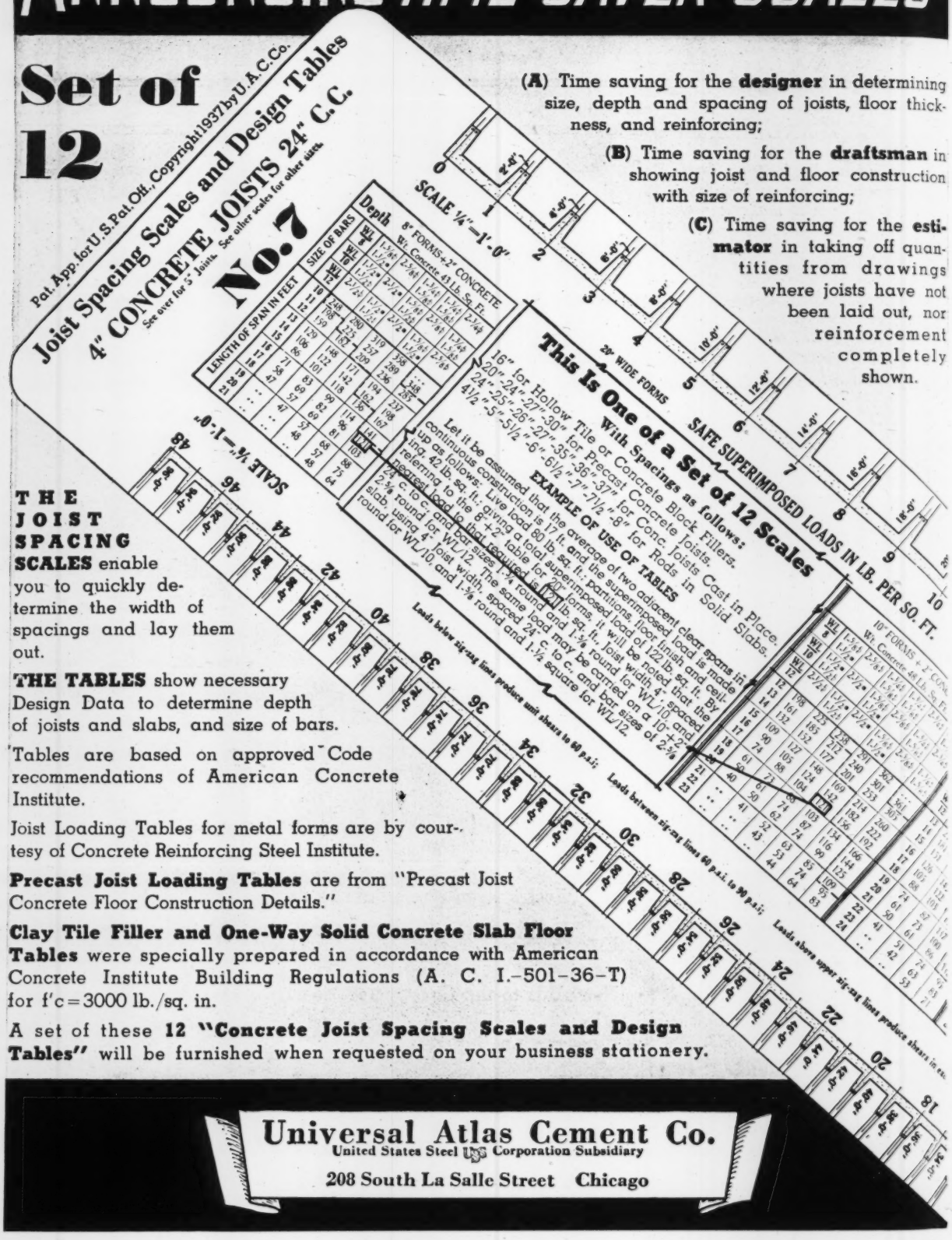
THE COVER PICTURE is of the unique grade separation structure at 79th St. in Riverside Park, New York, which incorporates in levels below the roadways a river overlook promenade and a garage

ANNOUNCING TIME-SAVER SCALES


Set of 12
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Joist Spacing Scales and Design Tables
4" CONCRETE JOISTS 24" C.C.
See over for 5" Joists. See other scales for other sizes.
No. 7
SCALE ¼" = 1'-0"
SAFE SUPERIMPOSED LOADS IN LB. PER SQ. FT.
20" WIDE FORMS
This Is One of a Set of 12 Scales
With Spacings as follows:
16" for Hollow Tile or Concrete Block Fillers.
20"-24"-27"-30" for Precast Concrete Joists.
24"-25"-26"-27"-35"-36"-37" for Conc. Joists Cast in Place.
4½"-5"-5½"-6"-6½"-7"-7½"-8" for Conc. Rods in Solid Slabs.
EXAMPLE OF USE OF TABLES
Let it be assumed that the average of two adjacent clear spans is 24 ft. and the superimposed load is made up as follows: Live load 80 lb. sq. ft.; partitions, floor finish and ceiling, 42 lb. sq. ft.; giving a total superimposed load of 122 lb. sq. ft. By referring to the 8"+2" table for 20" forms, it will be noted that the nearest load to that required is 127 lb. sq. ft.; Joist width 4", spaced 24" c. to c. and bar sizes 1-¾ round for WL/10 and 2-⅝ round for WL/12. The same load may be carried on a 10" joist slab using 4" joist width, spaced 24" c. to c., and bar sizes of 2-⅝ round for WL/10, and 1-⅞ round and 1-½ square for WL/12.
Loads below zig-zag lines produce unit shears to 60 p.s.i.
Loads between zig-zag lines 60 p.s.i. to 90 p.s.i.
Loads above upper zig-zag lines produce shears in ex.
LENGTH OF SPAN IN FEET
Depth
SIZE OF BARS
8" FORMS + 2" CONCRETE
Wt. Concrete 63 Lb. Sq. Ft.
10" FORMS + 2" CONC.
Wt. Concrete 48 Lb. Sq. Ft.

(A) Time saving for the **designer** in determining size, depth and spacing of joists, floor thickness, and reinforcing;

(B) Time saving for the **draftsman** in showing joist and floor construction with size of reinforcing;

(C) Time saving for the **estimator** in taking off quantities from drawings where joists have not been laid out, nor reinforcement completely shown.

THE JOIST SPACING SCALES enable you to quickly determine the width of spacings and lay them out.

THE TABLES show necessary Design Data to determine depth of joists and slabs, and size of bars.

Tables are based on approved Code recommendations of American Concrete Institute.

Joist Loading Tables for metal forms are by courtesy of Concrete Reinforcing Steel Institute.

Precast Joist Loading Tables are from "Precast Joist Concrete Floor Construction Details."

Clay Tile Filler and One-Way Solid Concrete Slab Floor Tables were specially prepared in accordance with American Concrete Institute Building Regulations (A. C. I.–501–36–T) for f'c = 3000 lb./sq. in.

A set of these **12 "Concrete Joist Spacing Scales and Design Tables"** will be furnished when requested on your business stationery.

Universal Atlas Cement Co.
United States Steel Corporation Subsidiary
208 South La Salle Street Chicago

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THE WEEK'S EVENTS

Building Workers Strike in Cincinnati

Six thousand construction workers and skilled craftsmen are idle in Cincinnati as a result of a strike for higher wages called by the common laborers' union June 1. All major projects in the city are closed down. The employers on June 8 made a revised offer of 70 c. for the remainder of this year and 75 c. from Jan. 1 to June 1, 1938. The old scale was 60 c. The union will meet June 10 to consider the offer.

PWA Life Extended Two Years

Continued to July 1, 1939, with provision limiting future allotments to projects already under application

The House of Representatives on June 7, without a record vote, passed a bill extending the life of the Public Works Administration, which expires by law on July 1, 1937, for two additional years. A provision was included limiting future PWA allotments to projects for which applications are already on file, as of the date of final approval of the extension law.

Testimony before the Appropriations Committee, which reported the bill on June 3, revealed that the PWA revolving fund now contains $124,000,000 available for loans and $95,000,000 for grants, not including $53,000,000 which has been tentatively allotted but upon which final contracts have not been signed. The House authorized an additional $40,000,000 bringing the total amount available for further allotment to $259,000,000.

Testifying before the committee, PWA Administrator Harold L. Ickes stressed the need for continuation of the agency in order to wind up its business, particularly outstanding housing projects, recent loans to Pennsylvania, Kentucky, Colorado and Florida, and 63 power projects on which work has been suspended by court injunctions.

Bluestone Dam Plans Approved by Markham

Chief of Engineers Edward M. Markham has approved the plans and specifications for the proposed Bluestone Dam on the New River above Hinton, W. Va., prepared in the Huntington district office of the army engineers. Land and geologic surveys were completed last winter, and the project is now ready for construction as soon as funds are available.

Bluestone Dam, estimated to cost $13,000,000 is an important project in the flood control program for the Ohio River Valley. It will also reduce pollution in the Kanawha and Ohio Rivers during the summer months.

Three Killed, Four Hurt By Tunnel Blast

Three rock drillers were killed and four more injured, one critically, on May 28 by a blast in the west end heading of the rock tunnel of the north tube of the Lincoln tunnel at Weehawken, N. J. According to reports, the blast was caused by drilling into an unfired shot. The accident was the worst occurring on the project since April 8, 1935, when a shift superintendent and two men were killed by a blast in the Manhattan end of the south tube.

The west approach tunnel of the north tube is being driven by the Underpinning & Foundation Co., subcontractor for the Mason & Hanger Co.

Appropriation Assures High Dam at Coulee

Grant of $13,000,000 to Department of Interior regarded as commitment to complete Grand Coulee project

Completion of the High Dam at Grand Coulee has been assured by approval of a grant of $13,000,000 to the Department of the Interior by the House Appropriations Committee. Though the Senate has not as yet approved the appropriation, advice from Washington states that no trouble is expected in the passage of the bill. In 1937 the Interior appropriation act specified that the obligation for the construction of Grand Coulee Dam should not exceed $63,000,000. This amount is sufficient only for completion of the low or foundation section of the dam, now under construction. Since a sum of $7,250,000 would complete the $63,000,000 authorization, the appropriation of $13,000,000 is regarded as a commitment to go ahead and complete the high dam.

The low dam, being built by the Mason-Walsh-Atkinson-Kier Co., will be completed by the first of next year. The present contract will expire with the completion of foundation work, but by that time the Reclamation Bureau expects to have awarded a new contract carrying the high dam through to completion. Detail plans of the top structure are now being prepared by the Bureau's engineers.

The $5,750,000 in excess of the amount required to complete the low dam will, of course, only be a part of that required for the high dam.

Bids Asked for Ruby Dam

The Seattle, Wash., board of public works will open bids July 1 for the construction of a concrete arch dam at Ruby Creek on the Skagit River project. Present plans call for construction to Elevation 1,280, only a part of the ultimate height. The city has $4,500,000 available for the project, of which PWA supplies 45 per cent and the city, through bonds already sold, 55 per cent. Plans are available from the city light engineering department.

$800,000,000 Flood Control Plan

Protection of Ohio and Mississippi Valleys requires many reservoirs, walls, channel improvements and floodways

A flood control program for the Ohio and Mississippi Rivers and their tributaries, to cost $800,000,000 is proposed by General Edward M. Marham, Chief of Engineers, according to a report made public at a hearing before the House flood control committee on June 7. Protection from floods would be accomplished by construction of numerous dams creating detention reservoirs on the tributaries, by building of miles of levees and river walls for local protection, by increasing carrying capacity of the rivers through channel improvements and by establishing floodways on the Mississippi. The report, prepared in the light of the disastrous floods of January and February, 1937, recommends the contribution of about one-third of the entire expense by local interests.

The committee has before it a bill introduced June 4 by its chairman, Rep. W. M. Whittington of Mississippi, authorizing the construction of levees, flood walls, and drainage structures for the protection of twelve Ohio valley communities at a total cost of $36,122,000, including $11,245,000 for lands and damages. This was described as being acceptable under the Administration's economy program.

Reservoirs not opposed

General Markham appeared before the committee, gave a brief outline of his report, and stated the policy of the Corps of Engineers toward flood control through reservoirs. It is a mistake, he said, to assume that his organization opposes reservoir construction, as has been stated. Heretofore it has faced the task of protecting the alluvial valley of the Mississippi within fixed financial limits; to accomplish this it has been necessary to spend every dollar in such a way as to get the utmost in protection, which has meant levees and channel improvements. With more money available, the Corps of Engineers favors the construction of storage reservoirs where economic justification can be established, although the General pointed out that the net result, as measured by actual reduction in flood crests, is usually disappointing to reservoir advocates.

The history of recorded flood disasters, the General continued, reveals that storms causing unusually high water normally center very near the Ohio and Mississippi channels, and that the rate of rainfall decreases at points farther removed. For example, the highest precipitation during the storms that caused the 1913, 1927, and 1937 disasters occurred not over 50 miles from the Ohio River. Under such circumstances the value of headwater reservoirs is lessened.

General Markham's report stated that the 1937 flood on the Ohio was of unprecedented size, reaching almost to the heights that previous calculations had determined to be the maximum possible. Had the fourteen storage reservoirs already authorized been in operation, they would have reduced crest heights by 5.5 ft. at Pittsburgh, 1 to 2 ft. at Cincinnati, and less than half a foot at Louisville and Cairo. Manifestly, therefore, additional protection is needed. Additional reservoirs are recommended at 45 points, with a total cost of $245,958,000, to bring the crest reduction to 5.5 ft. at Pittsburgh (no change) 7 to 8 ft. at Wheeling, 4 ft. at Cincinnati, and 2 ft. at Louisville.

In order to protect centers of population from damage, even at these reduced crest heights, additional levees and river walls will be needed by 155 communities. The construction cost of these would aggregate $190,000,000 exclusive of lands and damages, which would add $40,000,000. In some cases it would undoubtedly be more economical to relocate smaller communities than to attempt their protection.

Along the Mississippi River between Cairo and the confluence of the White and Arkansas Rivers, the report recommends that the super-flood estimate be increased from 2,250,000 sec.-ft., the figure hitherto assumed, to 2,600,000 sec.-ft. Because levee heights in this section are already as great as is considered prudent, the increase in capacity should be provided by the continuation of channel improvements and by the construction of seven storage reservoirs on lower tributaries of the Missouri and three on tributaries entering the Mississippi below Cairo. The ten reservoirs would cost $72,600,000 for construction and $80,800,000 for land and damages to existing property.

To reduce the burden of the Mississippi further down seven additional reservoirs are recommended on the Arkansas and six on the White, at a total cost of $81,600,000, as well as an additional flood control reservoir, with power development, on the lower section of the Red River at Denison, Texas. The latter would cost $35,000,000 plus land and damages of $6,700,000.

Bonneville Contractor Denied Tax Hearing

The Oregon supreme court has denied a petition for rehearing in the suit of Guy F. Atkinson Co., contractor on the Bonneville dam, against the State Tax Commission, involving right of collection of approximately $250,000 in state income taxes on profits from the dam construction. Attorneys for the Atkinson company said they contemplated an appeal to the U. S. Supreme Court.

The case has been in the state tribunal ever since last fall when the lower court held in favor of the tax commission. On appeal to the state supreme court, the decree of the lower court was reversed in favor of the company. The commission petitioned for rehearing, obtained it, and won a reversal in its favor a few weeks ago. It was from the last decision that the company petitioned for rehearing.

A companion suit, that of Winston Bros. vs. State Tax Commission, involving construction on a federal jetty project on the Lower Columbia River, failed in its appeal to the U. S. court when that body declined to take jurisdiction on May 11. Similar cases that arose on the construction of the Grand Coulee dam in Washington are on appeal to the federal tribunal and will be reheard in October.

• • •

Heavy Rains Flood Western Streams

Unusually heavy rains in the parched dust bowl areas of Texas, New Mexico and Oklahoma in the last ten days have sent normally dry streams on a rampage of floods. The city of Roswell, N. M., was flooded on Memorial Day weekend as waters from swollen Pecos River swept 5 ft. deep through the business district, undermining pavements and damaging building foundations. The partially-completed Alamogordo Dam, above the city, is credited with reducing the flood height, for though the 12-ft. diversion tunnel was carrying a full load, water backed up behind the rock fill embankment. A recurring flood later in the week again threatened to overtop the dam, as improvised dikes diverted the flow through a temporary spillway.

McMillen Dam, also on the Pecos, was hurriedly reinforced with 15,000 sandbags as the second flood threatened to overtop the structure. Citizens of Carlsbad, N. M., were prepared for orderly evacuation in case a bad break should occur in the dam, which is located 18 miles above the city.

The Canadian River in Oklahoma was reported to be cutting its banks badly, with the possibility of change of course in some localities.

THE CURRENT TREND

This week's news of contract volume and construction cost factors

Ahead By a Nose

Total of construction contracts passes last year's cumulative figure for first time

The prediction made last January that 1937 would be a better construction year than 1936 is at last assuming some basis in fact. During May the total of construction for the year to date crossed last year's curve for the first time, an event graphically portrayed in the "ENR Construction Volume" chart at the right by the relative position of the white and black arrows denoting the 1936 average week and the average 1937 week to date.

Ahead, if only by a nose, construction volume still points definitely upward. The backbone of the advance, also as predicted, is private work, in contrast to the huge shower of public contracts that descended in the first few months of 1936. It was this abnormal public-works volume—due to the PWA's deadline for money requests—which made last year's curve so difficult to overtake.

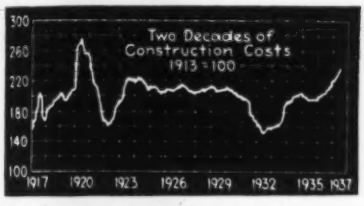
Now that the objective has been attained, can it be maintained? The immediate future looks promising. Industrial building awards show no sign of slowing down from their phenomenal pace of $40,000,000 a month. Commercial buildings, principally apartment houses, have increased 150 per cent over last year. The period of sustained highway lettings is here.

A retarding influence exists in the field of federal and municipal public works, lagging 30 per cent behind last year's totals. This however should not alter the general picture. On present outlook the forecast is decidedly favorable.

• • •

Costs Continue to Mount

Evidence that construction costs have entered new high territory continues to accumulate. Going back to the beginning of 1936: The ENR cost index, containing steel, lumber, cement and common labor, then stood at about 195, as compared to 210 in 1928-29. Since then, it has climbed to 237, a figure exceeded only during the price inflation of 1920.

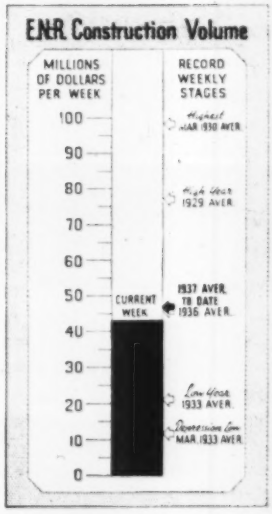


Among the four components of the index, cement alone is free of blame for the present situation. Six months ago steel and lumber gave the index figure a substantial boost, and now lumber and labor give it another. From $54 to $67.50 per 1,000 ft. b.m. is lumber's record in 18 months, during which period common labor rates rose from 55 to 64 cents an hour. Steel, now $2.25 a hundred pounds, was $1.80 at the beginning of 1936. This is the situation at which the American Institute of Architects pointed a warning finger last week by delegating a committee to examine the facts behind mounting construction costs.

• • •

Steel Production Drops

Steel strikes, affecting Republic, Inland and Youngstown Sheet & Tube, have dropped steel ingot production from its recent 91 per cent figure to 76 per cent. Finished steel deliveries will feel the effects before the month is over.



THIS WEEK'S FIGURES

CONTRACTS

(Thousands of Dollars)

	Week Ending June 11 1936	June 3 1937	June 10 1937
Federal	$5,699	$6,510	$5,052
State & Municipal	18,630	17,886	20,676
Total public	$24,329	$24,396	$25,728
Total private	11,297	11,210	17,155
WEEKLY TOTALS	$35,626	$35,606	$42,883
1937 (23 weeks)			$1,049,518
1936 (24 weeks)			$1,016,389

Note: Minimum size projects included are: Waterworks and waterways projects, $15,000; other public works, $25,000; industrial buildings, $40,000; other buildings, $150,000.

NEW PRODUCTIVE CAPITAL

(Thousands of Dollars)

1937	Week June 10	Cumulative
PRIVATE INVESTMENT	$5,599	$510,098
State and municipal bonds	5,525	243,013
Corporate securities	74	267,085
FEDERAL FINANCING	....	$70,788
PWA non-federal Projects	....	40,856
R.F.C. Loan	....	29,932
TOTAL NON-FEDERAL	....	$580,886
Federal projects	....	.....
TOTAL	$5,599	
1937 (23 weeks)		$580,886
1936 (24 weeks)		$417,698

Note: Figures include private bonds and stocks sold for new construction purposes; state and municipal bonds for construction; PWA loans and grants; 25 per cent of WPA construction appropriations.

Contract awards for the week, as detailed above, total $42,883,000, representing in private work a 52 per cent gain over the corresponding week last year and in public work a 6 per cent gain. Bridge construction, with $3,647,000 in awards, reached its highest weekly figure of the year. Streets and roads, at $11,344,000, registered its second highest week. Another star performer was commercial buildings at $8,152,000.

Only $5,599,000 of new construction money became available during the week, and nearly 99 per cent of this was in state and municipal bonds. Corporate issues are apparently waiting a more receptive investment market.

THIS WEEK'S LARGE CONTRACTS

Plant—Habirshaw Cable and Wire Co., Yonkers, N. Y. $1,000,000
Housing—Brewster Project, Detroit, Mich. 2,971,000
Highways—
Illinois 791,000
California 646,000
Kentucky 1,007,000
Missouri 1,290,000
New York 595,000
Bridge—Howard St. approach, Baltimore, Md. 1,270,000
Core Wall, etc.—Bills Brook Dam, Hartford, Conn. 1,588,000
Pipe Line—Barnsdall, Okla., to Kansas City, Kan. 200,000
Transmission Line—235 mi. Sou. Cal. Edison Co. 3,000,000

Life Insurance For Buildings

New York law now permits insuring of structures and equipment against depreciation

Life insurance for buildings in New York State is now possible under a law passed by the 1937 legislature and signed by Governor Lehman. The new measure permits the formation of insurance companies to write insurance policies for buildings and equipment, a new principle of insurance in this country although reported to be used successfully in certain European countries for the past several years. Under the plan, mortality tables are established covering service life of buildings, machinery and equipment, and policies and premiums will be formulated based on the estimated "life expectancy" of a structure at the time the policy is written. Underwriters estimate 40 years as the life expectancy of the average commercial structure.

Under the terms of the law underwriting companies may insure a structure "against total loss or damage including total loss of use by reason of the total depreciation existing at the expiration of the insurance." As is the case with life insurance, a policy covering a comparatively old building would require a proportionately higher premium rate than a modern structure. Some authorities view the new law as making it possible for an owner of a building who has paid premiums for 40 years to turn it over to the wreckers at that time as obsolete and collect the full amount of the policy.

The operation of the new law is expected by many to have an important effect on the insurance underwriting business in the state; also to materially affect the building industry in future years as this type of insurance coverage advances.

Companies writing this type of insurance must be capitalized for at least $1,000,000.

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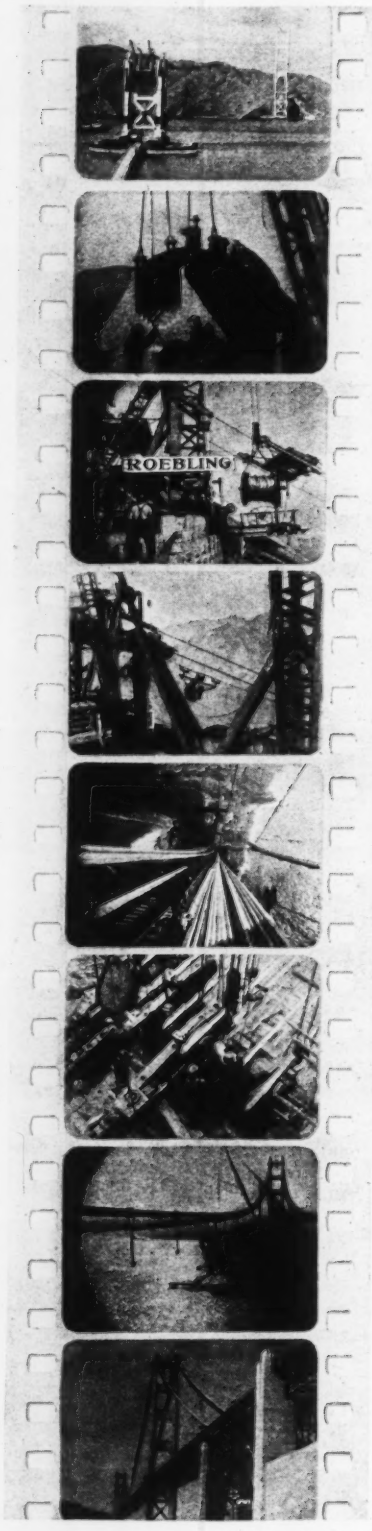
Hail, Hail!

Add climatic insults heaped upon the long-suffering residents of Southwestern Oklahoma—hail pounded a 200-sq. mi. area for an hour and a half on June 7, destroying an estimated 600,000 bu. of wheat in Harmon County, and causing damage to other crops. Unusual sleet and snow storms last winter, drought and dust storms this spring, cloudburst rains the last two weeks and now hail, which piled up 6 ft. deep in the gullies, have exhausted the patience of the natives.



GOLDEN GATE BRIDGE MOVIES

SELECTED scenes from a sound film made by John A. Roebling's Sons Co., cable contractor on the great suspension bridge that was opened on May 28.

Pennsylvania Fires Chief Road Engineer

Governor Earle removes H. H. Temple for alleged connection with purchase of inferior gravel

Acting on a report made by the state police, Gov. George H. Earle of Pennsylvania has ordered Secretary of Highways Warren Van Dyke to dismiss H. H. Temple, chief engineer of the highway department, for his alleged connection with the so-called "Erie district gravel scandle." E. A. Griffiths, who was in charge of highway district No. 1 during the period in which "the questionable practices in Erie county were permitted to develop" was also removed.

Governor Earle also ordered that the Pioneer Materials Co., of Kittanning, Pa., be barred from further bidding on state purchases of gravel. Mr. Van Dyke was further ordered to make any "additional changes in personnel in the central office and in the district which will tend to improve the service of the department to the citizens of that section of the state."

The state police investigation was ordered by the governor when the Erie Daily Times reported that thousands of tons of gravel used for highway construction in the Erie district was of inferior type. The police report indicated the state was paying the highest prices for its gravel, as high as $1.75 per ton, although the delivered grade was far below specification requirements.

Mr. Temple, formerly chief engineer of the Pittsburgh & West Virginia Railroad, entered the highway department as chief engineer with the advent of the present Democratic administration.

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Iowa Highway Commission Probes Identical Bids

Receipt of eight identical bids for 400 tons of calcium chloride has resulted in the Iowa state highway commission requesting that the office of Attorney General John H. Mitchell conduct an investigation. The highway officials admit that the price quoted, $24.50 a ton with a 1-per cent discount for payment within ten days, is not exorbitant. They also state that in the past calcium chloride bids have always been identical, and that this is the first time the question has been put up to the Attorney General's office. The investigation of identical bids would be based on an Iowa law prohibiting corporations, associations or individuals from entering into "trusts, pools, agreements, combinations or understandings to fix the price of any article."

Arnold G. Chapman Dies

Arnold G. Chapman, consulting engineer, Albany, N. Y., until recently chief engineer of the Albany Port District Commission, died in New York on June 3. Mr. Chapman had a heart attack in New York on May 21 while attending the board meeting of the New York State Society of Professional Engineers, of which he was a past-president. Since then he has been too ill to be moved to his home in Albany.

During the past ten years Mr. Chapman gave generously of his time to the advancement of the engineering profession in New York state, taking active part in defending and perfecting the engineer license law and serving as chairman of the legislative committee of the N. Y. State Society of Professional Engineers.

Arnold Chapman was 52 years old at the time of his death. Born in Guilderland, N. Y., he graduated from Union College in 1906. Previous to graduation he was on the staff of the New York state engineer and he returned to that work in 1906 rising to the position of deputy state engineer in 1913. Subsequent to 1915 he was in private practice or was acting as engineer for several state bodies. When the Albany Port Commission was set up he was made chief engineer, and in this capacity was responsible for the construction of extensive port facilities, including several wharves and grain elevators.

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Interest Revived in 30-mile Cascade Tunnel

The proposal to build a 30-mile highway tunnel through the Cascade Mountains in Washington at a cost of $60,000,000 was revived last week as advocates of the tunnel project sought the advice of Joseph B. Strauss, engineer of the Golden Gate Bridge. The tunnel as now proposed would carry traffic from Leavenworth to Skykomish, east of Seattle, in a four-lane automobile road and a second deck for trucks and trains. The tunnel would shorten the present route between the two points by 70 miles.

Mr. Strauss said that ventilation of the long tunnel would be possible through deep shafts, but suggested an alternate proposal of an endless belt to carry vehicles without using their own power.

Mr. Strauss suggested that the procedure used in the Golden Gate Bridge organization for financing, which involved the creation of a local district authorized by legislative action. Two other routes have been suggested, nearer the top of the mountain, one of which would be 8½ miles long, the other only 2 miles.

New Conservation Districts

President advocates seven new authorities for development and control of natural resources of entire country

Division of the United States into seven regions, and the setting up in each of these of authorities to plan and, under certain circumstances, to execute measures for the conservation and regulation of water, hydroelectric power, soil, forests, and other natural resources was recommended by President Roosevelt in a special message transmitted to Congress on June 3.

Pointing out that floods, droughts and dust storms are warnings that "we must act while there is yet time if we would preserve . . . the natural sources of a virile national life," the President stated that, although conservation is undoubtedly a national problem, its consideration should start from the bottom; that the problems of townships, counties and states should be coordinated through regional planning bodies, and the proposals of the regions, in turn, by a national planning body, such as proposed in his plan for governmental reorganization, so the final presentation to Congress would be a complete picture in which the relative importance of every local project had received consideration.

Specifically, the President proposed that regional bodies be established as follows: (1) the Atlantic seaboard; (2) the Great Lakes and Ohio Valley; (3) the present Tenessee Valley Authority, expanded to include the Cumberland and eastern tributaries of the lower Mississippi; (4) the Missouri and the Red River of the North; (5) the Arkansas, Red and Rio Grande, with intervening streams; (6) territory draining into the Pacific from the Colorado River to the California-Oregon boundary; (7) The Columbia River Authority. The present jurisdiction of the Mississippi River Commission over flood control and navigation would be left undisturbed.

Of the proposed authorities, only the TVA, MRC and CVA would function as more than planning bodies for the first few years. The first two are already functioning; the Columbia Valley Authority would be faced with the immediate necessity of marketing surplus power produced by the Bonneville project, to be completed late this year. The others would concentrate their activities in the development of integrated programs in the fields now covered by numerous federal, state and local agencies in the conservation field and would submit annual reports to the President recommending, in the order of importance, necessary improvements in their respective regions. These would be checked and co-ordinated by the National Resources Committee or a similar body to be established so as to present a unified national program.

Shortly after the message had been read in Congress bills to put its recommendations into effect were introduced by Senator Norris of Nebraska and Rep. Mansfield of Texas. While both followed the pattern set in the message, they differed in minor particulars. The Norris bill sets up, in each of the seven regions, three-man authorities modeled after the TVA, to which it grants full power to buy or condemn necessary real or personal property. Each Authority shall prepare an annual construction program for submission to the President and through him to Congress covering projects relating to navigation, flood control, soil conservation, reforestration, the manufacture of fertilizers, water purification and pollution control, irrigation and drainage, and hydroelectric power development. Construction of such projects may be entrusted by Congress to the authority or to any other federal agency. In marketing power, preference is to be given to public and non-profit enterprises, and authority is granted to build or buy transmission lines, substations, and other necessary facilities, and power contracts may be entered into with public or private agencies. When such power is to be resold, resale rates may be included in the contracts to insure "rates which are reasonable and nondiscriminatory." Each authority is the arbiter of its own rates, and determines the proportion of its costs to be charged against the production and distribution of power.

The Mansfield bill differs from the Norris bill in a number of particulars. In place of three-man authorities, it substitutes, in each region with the exception of TVA, a regional planning director to be assisted by a regional conservation committee. In selling power, the rates of each region shall be submitted to the Federal Power Commission and shall not be effective until approved by that body. Creation of a Columbia Valley Authority to take over the Bonneville project is specifically authorized. In general, the Mansfield bill regards the regional agencies as planning bodies, whereas the Norris bill implies that they will very quickly become construction and administrative organizations.

Rep. Rankin of Mississippi, expressing dissatisfaction with the Mansfield Bill, introduced a second House bill which is identical with the Norris bill in the Senate.

Labor Chiefs Support Wage Bill

Greene and Lewis favor Black-Connery government labor control measure but demand amendments at hearings

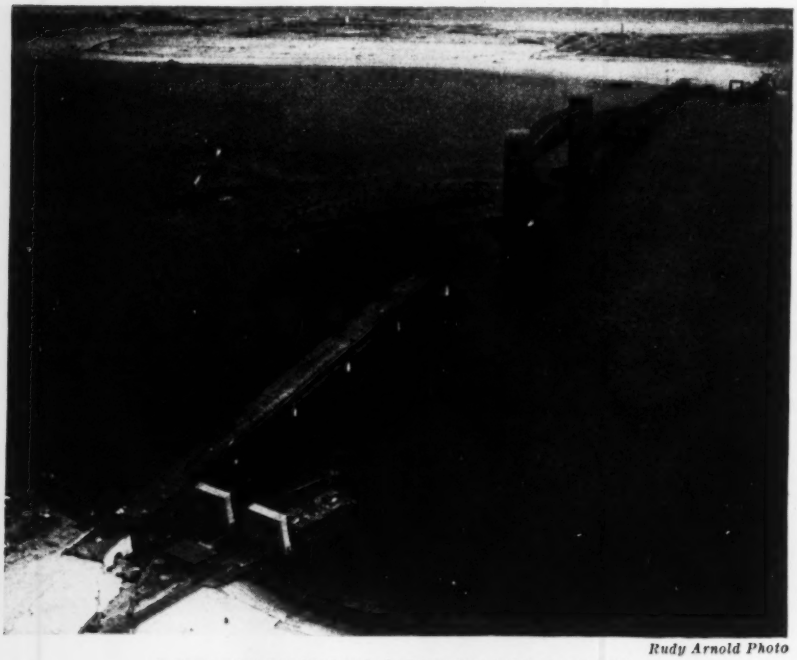
William F. Greene, president of the American Federation of Labor, and John L. Lewis, his rival as head of the Committee for Industrial Organization, appeared before congressional committee hearings as favoring the proposed Black-Connery wage and hours control bill, but each demanded certain amendments and revisions. However, though they differed materially in some respects, the labor leaders were united in contending that the Labor Standards Board, as set up in the bill, should not have the power to upset agreements reached by collective bargaining.

Whereas Greene tried to forestall the government taking labor leadership away from the unions by adding six amendments for strengthening labor's bargaining power, Lewis sought to achieve what amounts to the same thing by urging that Section 5 and provisions relating thereto be stricken out. Section 5 says that whenever the Labor Standards Board has reason to doubt the facilities for effective bargaining, it shall conduct an investigation, and with its findings as a basis, issue an order setting up fair wages and hours. It is interesting to compare the approaches of Greene and Lewis to the same end. Greene plead for the preservation of democracy in labor; Lewis plead for simplification of the bill, and said he feared if the Board set wages they would be thought of as fair and adequate. He wants to leave labor in a position to get a good living wage.

Lewis, representing CIO and United Mine Workers, supported the bill for four reasons: (1) increase mass purchasing power (2) will employ "hundreds of thousands" and take them off relief; (3) from a humanitarian standpoint to better the lives of a multitude; (4) from the view of industrial democracy it will enable millions to rise to industrial citizenship. He recommended a minimum wage of 40c. be written into the law; that 35 hrs., five days of 7 hr. each, be written into law, and give the Board authority to vary hours between 30 and 40 per week.

In the third hearing before the Congressional Joint Committee on June 4, William F. Greene, president of the American Federation of Labor, endorsed the principles of the Black-Connery wages and hours bill but stood firm against any power of a labor board to over-ride agreements by bargaining between unions and industry. He offered six amendments to that end as follows: (1) The act shall encourage collective bargaining, shall be so construed; (2) every order by the board shall contain a finding and legend to the effect that it is the result of a labor-employer bargain, and not a fiat of the board; (3) hours and wages widely accepted by the employers and workers or unions shall be accepted and fixed by the board as maxima and minima; (4) wage and hour standards determined by collective bargaining shall be deemed prima facia minimum wages and maximum work week unless such standards exceed or are less than standards established by competitors employing corresponding class or craft of labor; (5) the board shall deal with and recognize crafts as crafts; (6) when it is necessary for the board to prescribe regulation different than an agreement reached by bargaining, then the regulation shall be temporary and the bargaining agreement shall be deemed to remain in effect while the board regulation is on.

Mr. Greene recommended the 40-hr. basic week with power in the board to reduce the standard to 30 hrs., and an 8-hour maximum day.



Rudy Arnold Photo

LAST SPAN OF MARINE PARKWAY BRIDGE PLACED

RAPID PROGRESS is being made on the Marine Parkway Bridge across Rockaway Inlet, the entrance to Jamaica Bay, at New York City, and six months after the 540-ft. lift span was placed as the first superstructure operation (ENR Jan. 21, 1937, p. 109), all spans are in place. The bridge is about 3,800 ft. long, contains three 540-ft. through-truss spans at the center and continuous deck-truss span approaches. All spans were floated into place. In the above view, the Brooklyn abutment is in the foreground while across the inlet is Jacob Riis Park on the ocean front whose construction has paralleled that of the bridge.

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Pennsylvania R.R. Builds New Steam Locomotive

A new and distinct type of steam locomotive capable of hauling 1,200 tons —a 14-car passenger train—at 100 miles an hour, is being built by the Pennsylvania R.R. primarily for passenger service, though many of the improvements embodied in the new design are expected to be adaptable to freight operation. The new engine, to be known as the Pennsylvania Type, is a development of the conventional coal burning steam locomotive based on design developed by a committee of engineers of the Baldwin, American and Lima Locomotive Companies cooperating with those of the railroad..

The engine will be completely streamlined and will have much the same general appearance as the streamline type of heavy steam passenger locomotive now in service on the railroad. The outstanding features of the design is the use of four high pressure cylinders instead of two, each cylinder serving two driving wheels. A streamline tender mounted on two six-wheel trucks will carry 25,000 gal. of water and 26 tons of coal.

Sidewalks of New York Spread to Highways

Construction of sidewalks and installation of lights along state highways in New York outside of cities and villages will be provided for out of state funds in the future under terms of an amendment to the highway law passed by the 1937 Legislature and approved by Governor Lehman. The new measure will permit the superintendent of public works to let cohtracts for such improvements in cases where he considers them necessary, financing them out of funds available for construction, reconstruction or maintenance of state highways. The sidewalk construction and lighting installation features of the bill have been urged as safety measures for the past several years by city and village officials and by various civic bodies. More recently they were made the subject of recommendations by the Legislative Highway Survey Committee, the State Conference of Mayors and the State Planning Council. Under the former law the State Division of Highways was not permitted to use highway funds for any purpose other than highways; and municipal officials were without jurisdiction beyond city or village limits.

State engineers estimate that the sidewalk construction will cost on an average of $3,000 per mile. As a matter of policy they will construct walks where necessary at time of construction or reconstruction of the highway, making such improvement a part of the regular construction contract.

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New York Sewer Tunnel Holed Through on June 7

A 3¾-mile compressed air tunnel, part of the upper Manhattan section of the Ward's Island interceptor sewer project in New York City, was holed through on June 7, completing the longest stretch of tunnel ever driven under compressed air. The Manhattan interceptor extends along East and Harlem Rivers from E. 73rd St. to 164th St. In addition to the compressed air tunnel, the project includes 1¼ miles of rock tunnel and considerably open cut work. Considerable difficulty was encountered in driving the soft ground section because of the presence of old waterfront structures, rip rap and building foundation piling.

The Manhattan interceptor contract is held by the Rosoff Tunnel Corp. of New York. The project is part of the comprehensive program of sewage disposal facilities being undertaken by the Department of Sanitation, New York City. The work was financed partly by a 40 per cent grant from the Public Works Administration.

WASHINGTON HIGHLIGHTS

Special reports by Paul Wooton

A NUMBER OF BRIDGE bills received the approval of President Roosevelt on June 3. Included in the list were bills extending the completion date for bridges over the Chicago River near its mouth, and over the Michigan Canal at Chicago; across the Monongahela, Allegheny and Youghiogheny Rivers in Allegeheny County, Pennsylvania; and across the Ohio River between Rockport, Ind., and Owensboro, Ky. Also approved was a bill permitting the state of Mississippi to construct a free bridge over the Pearl River near Jackson, Miss.

The Senate on June 3 adopted a concurrent resolution requesting the President and the Administrator of PWA to resume allotments on the old 45 per cent grant basis in respect to school buildings needed to eliminate hazardous conditions. The resolution was introduced by Senator Schwellenbach of Washington, who pointed out that PWA now has 1,178 such applications on hand, of which only 35 have been able to comply with the new rulings limiting PWA grants to 115 per cent of the amount expended for relief labor, and that there is money available in the PWA revolving fund sufficient to finance all such applications without additional appropriations by Congress.

Secretary of Agriculture Henry A. Wallace has appointed Roy I. Kimmel of Amarillo, Texas, as coordinator of soil conservation, wind erosion and resettlement activities in 100 counties comprising 140,000 sq.mi. of territory in Texas, Oklahoma, Kansas, Colorado and New Mexico. Besides working with the various federal agencies, Mr. Kimmel will cooperate with state and local efforts to rehabilitate the Southwestern dust bowl, following the principles recommended in the recent report of the President's Great Plains Committee. Prior to his appointment Mr. Kimmel was in charge of the Resettlement Administration's rehabilitation program in the same area.

Congress completed action on June 7 on a bill modifying plans for the Illinois Waterway between Lockport and Chicago, Ill., by substituting for the natural channel of the Calumet River a straight artificial channel between 130th and 139th streets, Chicago. The bill now goes to the President for approval.

Detroit Housing Contract Let on Second Bidding

Contract for the Brewster slum clearance housing project in Detroit, for which bids were rejected last fall as being too high, was awarded last week by the PWA to the Maurice L. Bein Co. of Chicago. The contract price, $2,971,000 is $803,900 lower than the low bid submitted last fall.

Project will replace a slum area of eleven square blocks. It consists of brick and concrete three-story apartments and two-story row houses and flats, providing 701 dwellings for low income families. Heating will be from a central plant, every unit will be equipped with electrical refrigeration and cooking facilities and a private bath. The contract must be completed within 410 days.

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Flood Surveys Halted By Lack of Funds

Surveys and planning work for flood control of the upper Ohio River basin, being carried out by the U. S. Engineer Office in Pittsburgh, were halted last week by lack of funds. Lt.-Col. W. E. R. Covell, district engineer, announced that the money allocated last summer by President Roosevelt was exhausted, and the entire engineering and designing staff would be given a vacation. Colonel Covell said that the flood control planning program would suffer if funds were not available by the time the staff returns from vacation. A staff of engineers has been preparing plans for several proposed reservoirs in western Pennsylvania.

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Consulting Engineers To Operate Sewage Plant

Full responsibility for the operation of the $15,000,000 sewage disposal system at Buffalo, N. Y., for one year after its scheduled completion on June 30, 1938, will rest with Greeley & Hansen, of Chicago, consulting engineers for the Buffalo Sewer Authority. This action was taken on June 1, when a modified contract was arranged with Greeley & Hansen under which they will appoint a representative with full authority over operations for a year. He will be responsible only to the firm, and the latter to the Authority. The original contract with the consulting engineers placed responsibility only for design, supervision of construction and inspection of the system.

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MORE ENR NEWS OF THE WEEK will be found on pages 885 to 887, inclusive.

COMMENT AND DISCUSSION

Readers' opinions on matters that concern the engineer

Frame Analysis

Sir: In *Engineering News-Record*, April 1, 1937, p. 491, Donald C. Williams aptly describes the "relaxation method" of frame analysis. For details of the method he refers the reader to the paper by Prof. R. V. Southwell, its originator, in the *Proceedings* of the Royal Society of London.

Structural engineers on hearing of this new method of analysis will at once inquire as to its relation to the moment distribution method of Prof. Hardy Cross. Prof. Southwell answers this inquiry. He writes near the close of Part II of his paper: "Prof. Hardy Cross explains his method in a beautifully concise paper read before the American Society of Civil Engineers in 1929. . . . I did not become acquainted with it until 1933. . . . On consulting the original paper to see whether my ideas had been anticipated I found the question unexpectedly difficult to decide. . . . But his concern throughout his paper was with stiff-jointed frames—not with braced frameworks of the kind discussed here; and although he has taught the method to students since 1924, I have found nothing in published papers which suggests that ideas of Part I have been anticipated."

Part III greatly extends the scope of Parts I and II. In this part Prof. Southwell writes: "Prof. Cross's paper has brought into existence a very considerable literature concerning what are here 'relaxation methods,' but I know of no paper in which formulas have been derived for use in the general problem—that is, a three dimensional framework having some joints rigid and others free, which is also stiffened by diagonal or cross bracing, and, to which forces are applied not only at the joints but also at intermediate sections of the constituent members." Such formulas are given in Part III.

In *Engineering*, April 28, 1937, p. 459, H. J. Hopkins presents an extended article: "The Solution of Continuous Girders by the Relaxation Method." A seven-span continuous girder resting on rigid supports is considered; also the same girder resting on supports yielding under load. It is assumed in the article that the reader is familiar with Prof. Southwell's paper.

It may be noted that a recent British textbook, "The Analysis of Engineering Structures" by Pippard and Baker, devotes a few pages to the relaxation method as given by Prof. Southwell in his paper. Professor Garrelts of Columbia University, New York, includes the method in his assignments for graduate study.

New York, N. Y. ROBINS FLEMING
May 18, 1937

Level Lines at Lake Mead

Sir—In your editorial headed "No Misgivings" on page 754 of the May 20, issue of *Engineering News-Record* you state that the U. S. Geological Survey set accurate bench marks for use in checking on the settlement of the region adjoining Lake Mead. The work was not done by the U. S. Geological Survey. The U. S. Coast and Geodetic Survey ran 700 miles of better than first-order levels in 1935 at the request of the U. S. Reclamation Service for the purpose you have stated.

In connection with movements due to earthquakes I would like to call your attention to the fact that for a number of years the U. S. Coast and Geodetic Survey has carried on repeat triangulation in California to check horizontal earth movements. We have also executed first-order leveling in this same area and at Helena, Montana, to check vertical movements.

Washington, D. C. J. H. HAWLEY,
June 1, 1937 Acting Director,
U. S. Coast and
Geodetic Survey

Causes of Land Subsidence

Sir—The article on page 479 of the April 1 issue relating to the subsidence of the land surface in the Santa Clara Valley in California, was not alone of great interest, but the letter of O. E. Meinzer, U. S. Geological Survey, in your May 13 issue, commenting on this and ascribing the probable causes, greatly accentuates this interest.

There is little doubt that frequently the subsidence of areas of great extent is caused by the drainage from them of liquids. Mr. Meinzer has in mind water, but the same conditions would arise, although perhaps more retarded, from the withdrawal of oil.

The problem is rather a simple one, and readily understandable if it be remembered that any sub-surface formations such as sand or sandstones, were originally impervious rock material, and that after being broken down they contain voids or interstices surrounding the grains or particles. Dependent upon the weight of the original rock material, when entirely submerged, the loss in weight will be about 30 to 35 per cent, and, similarly, the increase in weight due to drainage and consequent loss of bouyancy run 60 to 65 per cent. This proportion holds irrespective of the voids ratio. As an example: If the original rock material weighed 162½ pounds, its submerged weight would be about 100 pounds, 62½ pounds being lost on account of the weight of the displaced water. Should the voids be 25 per cent, the resulting sand of sandstone would weigh 122 pounds, without moisture, and only 75 pounds if submerged in water, a loss in weight of 47 pounds. If we therefore consider a stratum of such sand 500 ft. thick, if immersed in water, the weight on the deepest layer of sand or standstone, would be 18¾ tons per square foot, while if the water were removed by drainage, the weight would be over 30 tons per square foot.

While in the above I have assumed a depth of sand, or sandstone, of 500 ft., which has been drained of liquid, there are, undoubtedly, many cases where wells—water or oil—would drain such strata to a depth several times this. In practically all cases where this occurred, the deeper lying formations would have had adjusted themselves to the overburden through centuries or ages of being adjusted to these. Drainage, therefore, would immediately subject these lower strata to an increase in stress that might readily increase the loading by 60 per cent. It at once becomes apparent that such increase would result in additional settlements, frequently increased by actual failure through

crushing of the finer grains of sand, or on account of the angular forms of some of the grains.

The weight of the liquids in the voids is, of course, transmitted not to the grains, but by means of the liquid itself through various capillary channels to great depth, so that even if impervious statifications of rock exist beneath the surface, these do not alter the condition with respect to the additional loading on the particles of soil material. The increase in loading given above, being based upon a vertical computation of weight, it should be remember that on account of the intersections of the cones of distribution of pressure, as represented by Boussinesq's formula, the concentrations at the center of the area under load, depending upon depth, will greatly exceed that along the margin or edge of the area drained, which very condition will be accentuated by the ground water or liquid slopes or hydraulic gradients, its greatest depth from the surface occurring where the wells are located.

While the explanation given by Mr. Meinzer ascribes such settlements to water drainage, they would apply with equal reason to oil drainage in oil sand or sandstones, and it would seem not improbable to ascribe to such perfectly logical causes subsidence and consequent so-called "earthquakes" in places like Long Beach, California. Of course, where the oil is replaced by water and there is no lowering of the surface of the hydraulic gradients of oil or water, such a condition would not occur, but in places, where, by reasons of pumpage and removal of liquid, such a lowering occurs, undoubtedly the deeper sand or sandstones, subjected to added compression would fail, in many cases with consequent soil arching and, eventually, with increased stresses, the arches breaking down resulting in failure with accelerated subsidence over large areas.

It is noted that in the Santa Clara Valley in California, the greatest subsidence, while not directly in the center of the area observed, nevertheless indicates it as the apex of an inverted dome, and in other respects closely follows the forms of subsidence or settlements incident to loading—the loading in this instance being the additional weight on account of drainage and hence the consequent loss of buoyancy.

It would seem timely to bring this to the attention of engineers and others interested, not alone in underground water supply for irrigation purposes, but those in our large oil fields where settlements are occurring or will eventually occur incident to the extraction of oil.

New York, N. Y. F. R. HARRIS,
May 21, 1937 Rear Admiral (CEC) USN, Retired

Riveted Indeterminate Bridges Safer

Sir:—You report the collapse of a 159-ft. through pin-connected truss bridge in your May 13, 1937 issue (p. 721). A large number of collapses of pin-connected truss bridges resulting in loss of lives and property are reported in every volume of your periodical back to the Quebec bridge disaster, where 80 lives were lost. In the writer's own experience a large western railroad company's 220-ft. span double-track pin-connected through truss bridge designed for E60 loading collapsed when a derailed coal car hit the end post of the bridge. On the same railroad the end post of a 136-ft. riveted pony truss span was hit and badly damaged by a derailment. This bridge was repainted at small expense.

In another case a derailed coal car broke the post and more than half of the top-chord section at the edge of the gusset plate at the fourth panel point of a simple but internally statically indeterminate riveted pony truss bridge. The diagonals, badly bent, pulled the damaged upper panel point down to two-thirds of the truss height. The bridge in this condition sustained the loaded coal cars. A three-span continuous riveted through-truss railway bridge did not collapse after being hit by six 12-in. shells which ripped out several floorbeams and stringers, broke the bottom chord and a number of web members.

These examples amply illustrate the considerable safety produced by the rigid connections of the truss members, which safety is still further increased by statically indeterminate arrangement of the truss system. Statically determinate pin-connected truss bridges are, on the other hand, the least safe structures. The breaking of only one of their members results in the immediate collapse of the structure.

The 1935 A.R.E.A. specifications recommend pin-connected trusses for spans of 300 ft. and longer. The previous A.R.E.A. specifications recommended pin-connected trusses from spans 150 to 300 ft. The 1935 A.A.S.H.O. specifications, which the A.R.E.A. also adopted for highway bridges, specifies only that half-through trusses shall be of the riveted type.

The recommendation of pin-connections in these specifications is based on an assumed harmful effect of the rigid connections, emphasized by the required provisions of the secondary-stress paragraphs. It is remarkable that the safety of structures is sacrificed to the fear of an effect which never caused a single accident in the history of bridge building. On the contrary, built structures, laboratory tests and theory unanimously proved that rigid connections represent a large excess safety if the design is based on the ideal hinged truss. The long row of disasters caused by collapsing statically determinate pin-connected bridges apparently did not impress the writers of these specifications as much as the fear of the secondary stresses, which may be of the same magnitude for pin-connections as for the rigid connections and which are absolutely harmless in case of properly designed rigid joints.

Among recently built important bridges the Mississippi River Bridge at New Orleans and the East Bay Crossing of the San Francisco-Oakland Bay Bridge are statically determinate pin-connected through structures. "The principal reason for the use of eyebars was that the designers had more confidence in the pin joints than in the heavy riveted splices." (ENR. Nov. 26, 1936, p. 738.)

The span-length ratios and the double-deck arrangement of the cantilever structure of the East Bay Crossing offered an unparalleled opportunity for the erection of a three-span continuous truss system where the long center span is stiffened by a light graceful arch. A continuous truss of the same height as the truss of this system could have been used to great advantage, instead of the five 504-ft. simple span pin-connected through trusses.

Steel bridge specifications should not recommend pin-connected structures but should give preference to statically indeterminate systems.

New York. LOUIS BALOG,
May 15, 1937 In charge of structural design, U. S. Flood Control Design Office

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JUNE 10, 1937

STEAM'S COMEBACK is foreshadowed in the Pennsylvania Railroad's announcement that in cooperation with the nation's three largest builders of locomotives it is undertaking to build a steam locomotive of radically new design for high-speed passenger service. Simultaneously the Burlington announces that it is to begin comparative tests of its new steam and diesel locomotives. And up in New England the New Haven is experimenting with a steam-driven power unit that is an outgrowth of the old "White Steamer" of early automobile days. All these events stand as evidence of the fact that the steam locomotive is not a thing of the past. Electrification of railway lines calls for investment hard to justify except on lines having dense traffic. Diesel locomotives not only are costly to build but have high maintenance costs, and little is known as to their useful length of life. Steam locomotives, on the other hand, cost relatively little to maintain and their life is long. Their chief fault has been low efficiency, but recent years have seen important change in this respect. With other improvements that now appear to be just around the corner, the steam locomotive may yet give its new competitors a hard fight.

For Safer Roads

THE SUCCESS obtained by a committee a few years ago in marking highways and standardizing highway signs promises a useful result from the work of the similar committee just set up to formulate practices of safe road design and construction. Sponsored by federal and state road officials, the committee has both the ability and the authority to redeem highways from the just criticism of being the most hazardous of modern engineering works. However, this is not an easy task, and boldness will be required to carry it through. Setting up numbered routes and uniform signs interfered with few prerogatives and infringed on only a fraction of the property interests that are involved in widening roads and providing sight distances adequate for safety. Nor are the physical difficulties of building safety into roads as easily overcome. But all these problems are known to the committee members, and they also know how high a standard must be set for complete solution. Roadbuilders and engineers quite as much as the public at large look to them to take their courage in hand and not hold back from the utmost in pointing out safe practices in roadbuilding. Safe roads must be built, and a long view must be taken in the planning of them.

Frontyard Frontiers

THE CRY that our frontiers are vanishing and opportunity with them has no application to the frontiers of community development. They, indeed, are ever broadening, until it is said that our cities require rebuilding every twenty years. Actually, and unfortunately, none of them has been rebuilt and, what is worse, large areas in most of them have never made acquaintance with a paint brush, much less experienced a remodeling. Of the many parts of our cities which are out of date, untidy and inefficient, none is more conspicuous than the waterfront. Here are frontiers in our very frontyards that offer opportunity for the exercise of many kinds of talent. Because this opportunity has been neglected while commerce on the one hand and squatter slum colonies on the other took over the waterfronts, it is largely the engineer's skill that must now be relied upon to make them more useful and more attractive. In New York City this process of reclaiming a neglected waterfront is currently under way, as described in this issue, for the shoreline along the Hudson River. Involved are express highway construction, park development and railroad grade separation work. While no project of similar magnitude is required in any other city, there is none but can use these same elements, plus stream pollution abatement, to make its waterfront more useful and more sightly. Some of them, including Chicago, St. Louis, Columbus and smaller cities have already taken steps in this direction. One can only hope that the examples so set will be widely emulated.

Cutting Through Congestion

FOR FULL APPRAISAL the West Side highway and parkway undertaking of New York City must be viewed in its relation to the outstanding city problem of today. Current experience reveals formidable weaknesses of the city facilities built by past generations; congestion, transportation difficulties, lack of coordination of housing with business, menace the city's wellbeing. The key problem is transportation. Tardily, one phase of this fundamental problem is being attacked by cutting trunkline thoroughfares through the obstructing maze of streets and buildings, or bypassing congested areas, when possible. The West Side parkway undertaking is the most sen-

sational current example of such action. Because it is coupled with other objectives almost as important, its interest is manysided and its physical problems are complex. Yet its overshadowing importance lies in the creation of an express route for street traffic over and around 20 miles of dense city congestion. It sets a noteworthy precedent in city development. Together with New York's new parkway entrances to Brooklyn and Queens, the proposed and partly constructed East River Drive, the arterial approaches to the Triborough Bridge, and the similar north-south trunk that is to be created by the Whitestone bridge and its associated thoroughfares, the West Side project marks the farthest step forward yet made in solving a modern city's arterial circulation problem.

Permanent Idleness

GOVERNMENT WELFARE OFFICIALS have predicted that we must look forward to a permanent unemployed army of five to six million. Since current estimates place the present number of unemployed at about eight million, the prediction implies that less than three million men will be reemployed by the time the country's productive machine reaches top capacity! Even stranger is the contrast between surplus manpower and shortages in manpower, for even now the steady rise in wage rates is accompanied by specific labor shortages here and there.

What are the facts back of these contrasts? The Bureau of Labor Statistics data on employment and payrolls show that the entire field of consumption goods is at or beyond prosperity level, both in number of persons employed and in total wage payment. But the heavy industries have made only partial recovery, and such important producing fields as brick, agricultural implements, cement and structural steel are well below the 80 per cent level. These employment data, closely checking our own contract figures, verify the picture sketched by the construction statistics given in our Annual Review issue four months ago.

Construction and its associated heavy industries are the only elements of industry that have not reached normal activity. When the heavy industries resume full functioning they will require fully half of the present unemployed to man their operations, and a further contingent will be needed to supply services to these heavy-industry workers. Predictions of an unemployed residue of five or six million therefore have no justification unless mismanagement of relief and welfare keeps men away from the jobs that need them. Except for the infirm and that proportion of casual laborers and wilful idlers that has always existed, it is out of reason to look forward to permanent idleness. That there is mismanagement of relief is found in the fact that relief workers continue to turn down jobs on normal construction work.

If, then, the return of the remaining unemployed to a condition of self-support waits on the further rise of construction, it is pertinent to ask how long this industry will continue at subnormal level. The answer given by the current increase in construction is favorable. Contract awards since the first of the year have steadily continued the rise that distinguished 1936, and the conditions underlying this rise are such as to give reason to expect further rise. Provided the advance is not interrupted by bad finance, by the restrictive influences of labor or regulatory efforts, or by other disturbances, it should soon have a decided effect on the unemployment roll. As this process goes on, the specter of a permanent army of unemployed will fade away.

It follows also that the best way to combat unemployment is to encourage the recovery of construction. Particularly the field of private construction is worth such help—most effectively given by removing the many uncertainties and threats that stand in the way of free expansion of production facilities.

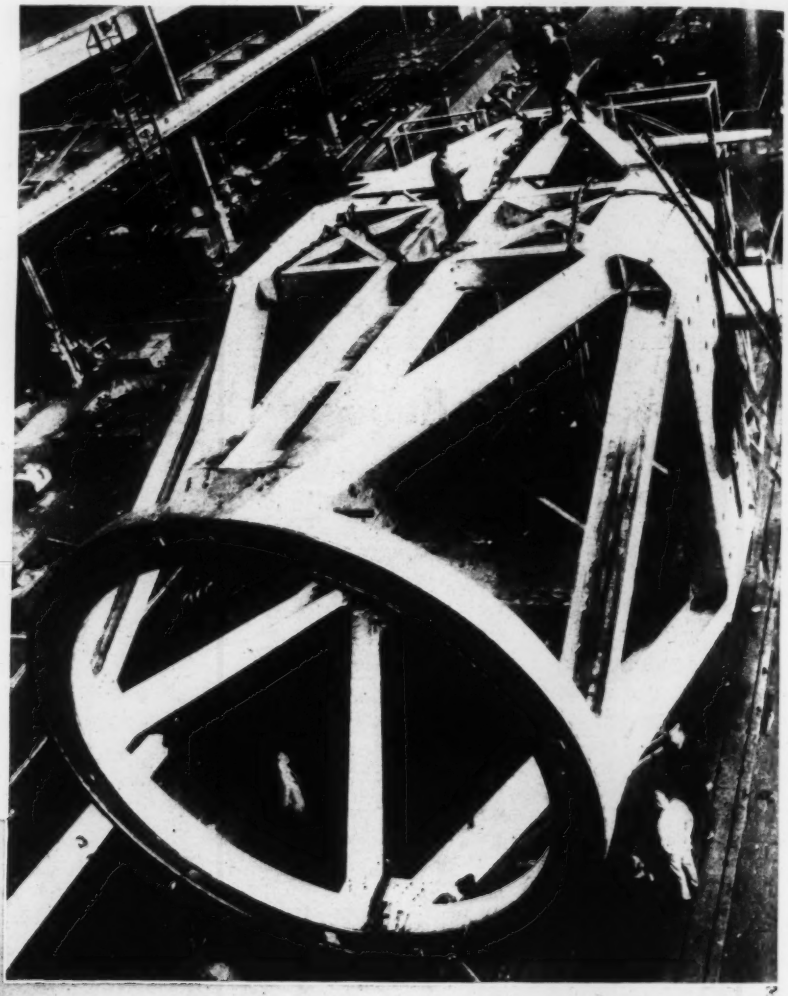
Continuing Advance

AS TRULY as power is the mainspring of the modern era, city sanitation is a measure of advance of the day's civilization. It is the sanitary engineer's work in providing ample and pure water supplies, universal sewerage, and safe and inexpensive disposal of refuse, that most definitely marks off the twentieth century from the past.

By the same token the amazing extension of community sanitation throughout the United States during the last two decades reflects the nation's accelerated progress. And it is a fact of profound meaning that sanitation advanced even more rapidly during the depression of the '30s. As evidence that public sanitation throughout the country was raised to a higher level during the last half-dozen years, authoritative figures show that in the field of sewage disposal the population served by treatment works has nearly doubled since 1932. The astonishing activity of the South that is sketched in this issue is but part of a nation-wide movement on a broad front.

But it is important to note that this movement represents merely the beginning of a continuing task. The sanitary needs of communities are increasing with each passing year, and even the most active work to improve city sanitation barely keeps pace with this increase. It is safe to forecast that the present rate of activity in sanitation will be maintained undiminished for many years to come, and that, in fact, it may be further increased by new needs.

PICTURES IN THE NEWS



STARGAZERS aided by the structural engineer. The tube for the 200-in. Mt. Palomar telescope being fabricated at the Westinghouse shops in Philadelphia. Flexible hinges (such as the ladder leans against) made the structure statically determinate. Welded shop connections, x-rayed and annealed, and bolted field connections provide the rigidity necessary for accurate astronomical observation.

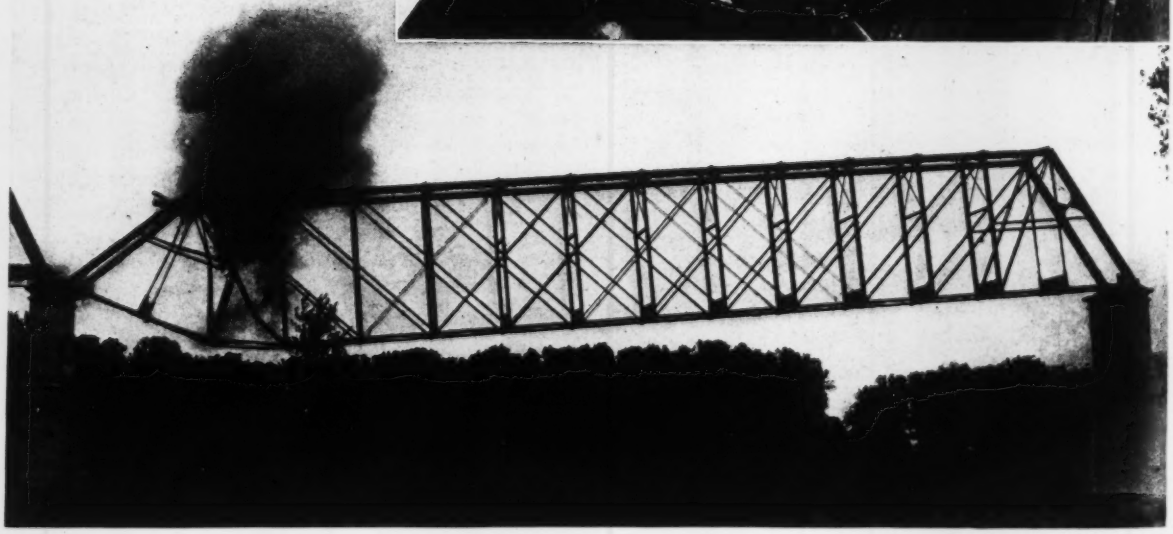


Photo by H. A. Ingmire

ITS USEFUL LIFE ENDED, the historic Wabash R.R. bridge at St. Charles, Mo., was dynamited late in May to simplify the dismantling work. The bridge had been in service 65 years.

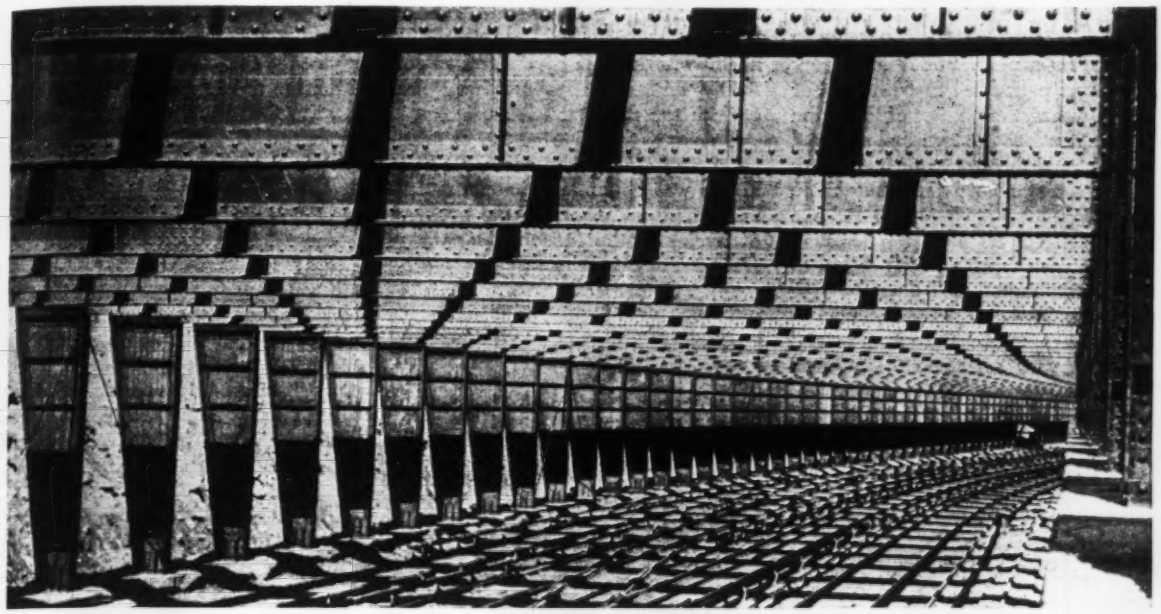


FIG. 1. BURYING A RAILROAD IN A STEEL RIGID FRAME SUBWAY BUILT ON TOP OF THE GROUND IN RIVERSIDE PARK.

Reclaiming a Riverfront

Cooperation between New York City and New York Central R.R. brings vast changes along Hudson River shoreline; latest work involves track covering, express highway building and park development along a 7-mile front

EXTENSION of New York City's remodeling job along its Hudson River waterfront into the uptown area of parks has resolved itself into the largest construction operation in the East. At the same time it is one of the most notable current undertakings in its technical details. From 72nd northward to St. Clair Place (129th St.), Riverside Park is being widened by new filled areas, a five-track railroad is being covered, an express highway is being built, and such park structures as field houses, playgrounds and wading pools are under construction. From St. Clair Place to Dyckman (200th) St., the express highway is being extended (on elevated steel structure where necessary), and new filled areas are being added to Fort Washington Park. At Dyckman St., connection is made with the Henry Hudson Parkway whose capacity will be increased by building a mile-long parallel roadway for one-way traffic through Inwood Park to connect with an upper deck to be added to the Henry Hudson Bridge over the Harlem River.

Construction operations thus are spread along 7 miles of Hudson River waterfront and, since a Fall date has been decreed for opening the express highway, feverish activity prevails. When the job is finished, however, a motorist leaving Westchester County's Sawmill River Parkway at the city line will be able to drive the 16 miles south to the Holland Tunnel at Canal St. without encountering a grade crossing. For the first 4½ miles, he will traverse the Henry Hudson Parkway, for the next 7 he will go over the viaduct and parkway now under construction, and for the last 4½ miles he will be on the city's West Side elevated express highway. Such a drive along New York City's Hudson River waterfront has been in the realm of dreams for so long that its reality assumes nation-wide importance.

Ingenious and complicated design, coupled with varied and difficult construction, have characterized the work between 72nd and Dyckman Sts. An expenditure of some $17,000,000 is indicated for the 57-block section from 72nd St. to St. Clair Place, and the north 71-block section to Dyckman St. will cost an additional $7,000,000. Substantial as these sums are, they are only a small part of the total that is involved in the complete plan of transforming transport facilities and developing the west side of Manhattan Island. Proper understanding of the present work above 72nd St. requires a review of the complete plan of what has been accomplished to date.

The West Side Plan

The New York Central Railroad's freight line enters Manhattan over a swing bridge spanning the Harlem

River at the extreme north tip of the island and for some 8 miles traverses (for the most part) undeveloped city waterfront park land to 60th St. For over 80 years, the 4 miles of line from 60th St. south to the terminal at Canal St., occupied the streets of New York City, and for nearly that long there was continuous agitation to remove the tracks. On its part, the railroad company was troubled with delays to freight movements and lawsuits over accidents. The city, likewise, had to countenance traffic tieups and fatal accidents year after year. Not until 1929, however, was it possible to effect an agreement on an improvement plan that was workable financially.

This agreement, with the prosaic title of West Side Improvement Plan, was signed on July 2 of that year and provided that the railroad company would remove all grade crossings along its line as far north as 60th St. (51 per cent of the cost to be borne by the state and the city), and that, north of 60th St., the railroad company would act as contractor for the city in building other structures that would remove the tracks from the surface and thus aid in the development of the Hudson River waterfront parks. These structures, as later designed, were to consist of a highway viaduct over the 60th St. yards to 72nd St., and granite-faced walls and steelwork supporting a highway and enclosing the tracks north of that point; the first section from 60th to 79th Sts. was to be begun immediately and paid for with money due the city by the railroad company (about $6,000,000) as a result of certain exchanges of lands and rights-of-way below 72nd St.

The viaduct section was built to 72nd St., and foundations and a retaining wall had been built to 79th St., representing an expenditure of about $3,000,000, when the depression made it impossible for the railroad company to carry on. In the meantime, however, it had expended $32,000,000 in elevating its tracks south of the 30th St. yards and another $52,000,000 north of 30th St. on plans and on land purchases for a depressed right-of-way which would accommodate the tracks from the 30th to the 60th St. yards. Concurrently the city, as an entirely separate undertaking, had built its West Side elevated highway from the Holland Tunnel north to 59th St. to a connection with the elevated highway that the railroad had built for the city from 72nd St. to 60th St. The plan, as stated, was to extend this highway from 72nd St. northward through Riverside Park on the top deck of a structure that would enclose the railroad tracks.

This was the state of the development early in 1934 when Robert Moses was appointed city park commissioner, and took up the problem of developing the Hudson River waterfront parks into something usable by the city. In a memorandum to the Governor on April 14, 1934, Mr. Moses recommended that the state loan the railroad company $7,000,000 from its grade crossing funds at a low interest rate, to enable it to complete the structure to 79th St. (requiring a $3,500,000 expenditure) and to finance its portion of the $16,900,000 worth of work remaining on the depressed line below the 60th St. yards; the balance of the funds for the latter work being supplied from state grade crossing allotments as a loan to the railroad and from direct state and city contributions. The recommendation was approved by the governor, and a special act was passed putting it into effect.

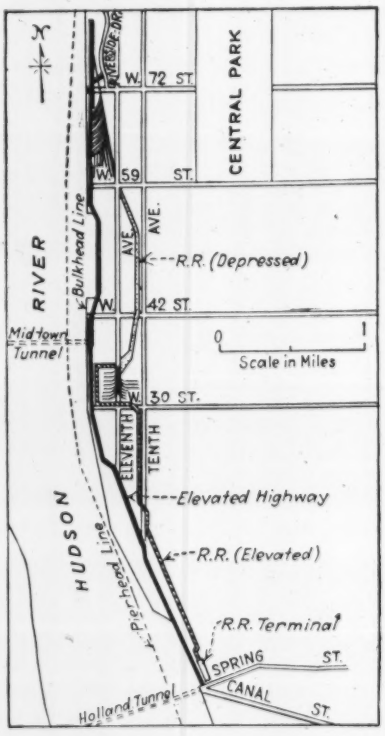


Fig. 2. Below 72nd St., traffic transformation is complete with highway and rail traffic removed from the surface streets.

On the map (Fig. 2) the railroad and elevated highway improvements below 72nd St. are indicated: the highway and the railroad elevated structure are in service, and on June 26, the first train will be run on the depressed railroad line between the 30th and 60th St. yards.

Plan changed in parks

As previously noted, the West Side agreement provided that the railroad tracks above 72nd St. be enclosed in a highway structure for the full eight miles to the end of Manhattan Island. This structure had been designed as a granite-faced box (the granite alone said to have been estimated to cost $30,000,000). Also, no provision was made in the plans for restoring the parks outside of the railroad right-of-way, or for improving the area west of the tracks along the waterfront. The park department took emphatic exception to the plan on the score of excessive cost and because it would result in cutting the narrow Riverside Park in two by a speedway on top of a structure which would rise above the park area.

A revised plan, therefore, was proposed, having park development as the prime objective but including both express highway construction and track covering. This new plan was practicable for immediate financing by city street improvement funds, and in addition represented a considerable saving over the expenditure proposed in the original design.

Above 72nd St., it was pointed out by the park department, the problem is one of parkway rather than highway construction, and it also involves the complete restoration or reconstruction of Riverside and Fort Washington parks. These are narrow "shoestring" parks with a varied topography, but with grades generally sloping abruptly from Riverside Drive (the existing street along the east boundary) to the railroad tracks and then to the river. It is said that there is no other park area in New York City which is subjected to such heavy and continuous usage.

Fundamentals of the project

Recognizing that there was probably no perfect solution to the problem, the park department nevertheless listed three fundamentals that should be present in any adopted plan:

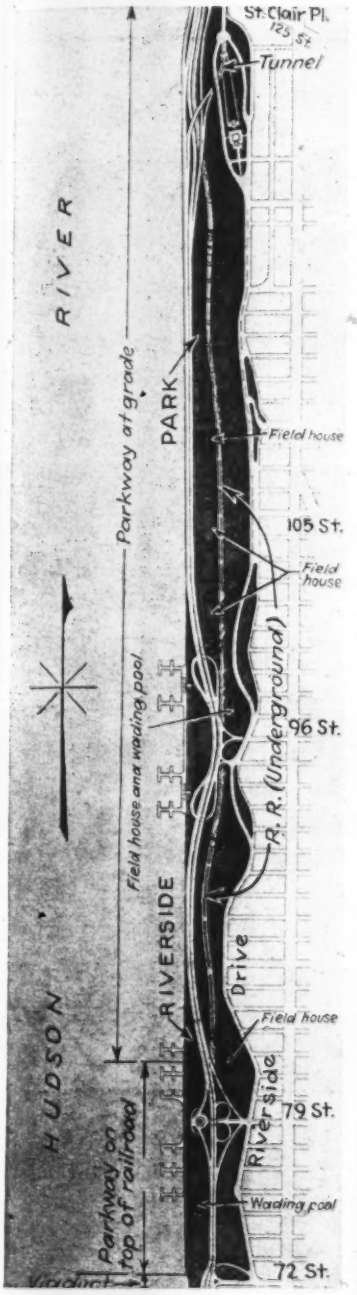


Fig. 3. **Structures in the West Side improvement program north of 72nd St. The map continues at the right of the page.**

(1) Reclamation of the area west of the tracks for active recreation.

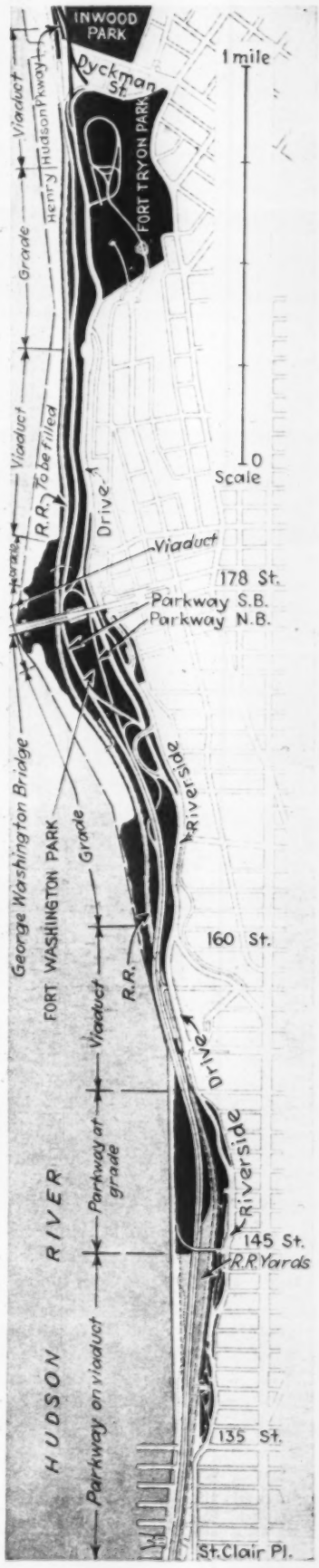
(2) Provision for easy access to this area over the railroad tracks, by roofing over these tracks.

(3) Provision for pleasure vehicle traffic along the waterfront on new filled land rather than on a structure over the tracks.

A plan containing these principles was approved by the city in the summer of 1935, and the three construction elements involved — highway, railway enclosure and park structures —are now taking shape. As shown in Fig. 3 (left half) the first ten-block section of the new highway north of 72nd St. is on top of the railway enclosure in accordance with the original plan, but at 82nd St. the road curves westward to follow the waterfront to St. Clair Place (129th St.), except for a return to the railway structure for a short distance at 96th St., to accommodate entrance and exit drives. The railway in this section is being enclosed and the park graded over it. Grade separation structures, providing access to the parkway, occur at 79th and 96th Sts., and in the vicinity of 125th St. a tunnel connection through a high bluff to Riverside Drive is planned for future construction. The 79th St. connection is made with an unusual three-level structure whose approach ramps on the west are incorporated in a building housing a garage and a river lookout and promenade. Recreation structures occur at various locations throughout the length of Riverside Park. A wading pool has been built at 75th St. and a second one is under construction at 82nd St. Boat basins are provided at 79th and 96th Sts., field houses at 75th, 83rd, 96th, 102nd, 105th and 109th Sts., and playgrounds for small children and sports facilities for others at numerous points.

North of St. Clair Place (Fig. 3, right half) the railroad tracks are not to be covered (at least under the present program), and a steel viaduct structure will be used for the highway as far as 145th St.; to 135th St. the viaduct will occupy an existing street while, beyond, it will traverse the New York Central R.R. yards. Above 145th St., the highway will come down to grade somewhat inshore from the river bank, but at 153rd St. it again will rise on viaduct in order to cross the railroad at 158th St. and enter Fort Washington Park; incorporated in this railroad crossing is to be the largest and heaviest plate girder in this country—190 ft. span and weighing 150 tons.

Throughout the south half of Fort Washington Park, the highway will be at grade, and in the vicinity of the George Washington Bridge, at 178th St., the northbound roadway will turn off to join Riverside Drive, which it will follow to Dyckman St. where it joins the Henry Hudson Parkway. The southbound roadway, however,



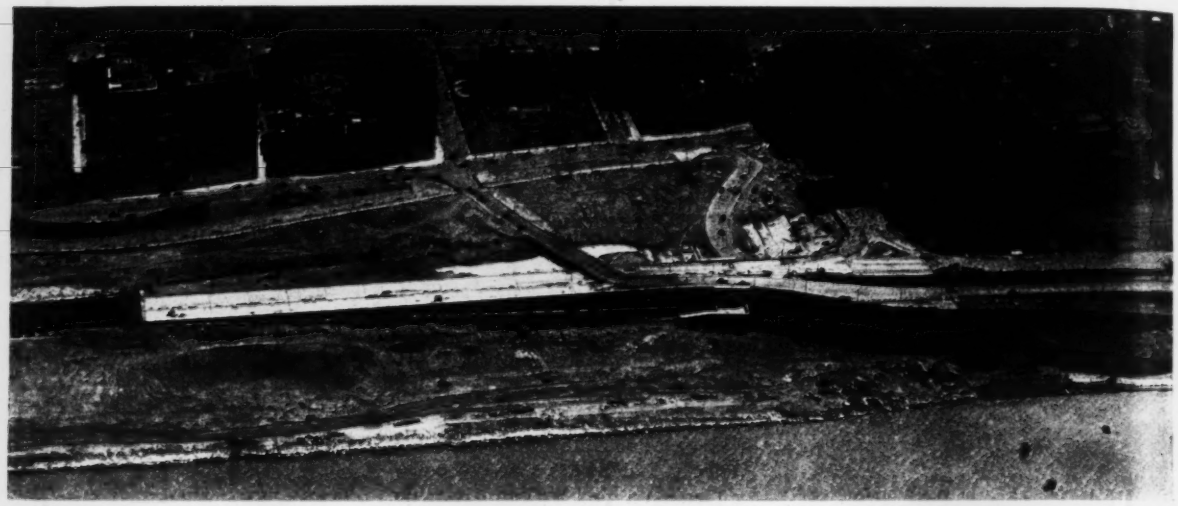


Fig. 4. South end of project at 72nd St. where connection is made with elevated express highway. New roadway is on top of the rail subway whose west wall is of precast-beam type buried under the sloping fill in the foreground.

will remain in the park and adjacent to the railroad, which in this area occupies a rock cut that is as much as 65 ft. deep at the George Washington Bridge. At this point the highway will be carried out over the cut on a side-hill viaduct, and this type of construction occurs again between 186th and 191st Sts. Beyond 191st St. there is a 6-block section at grade followed by a length of viaduct that curves out over the railroad tracks to clear an existing connection to Dyckman St. This viaduct joins the Henry Hudson Parkway at the entrance to Inwood Park. (Fig. 9).

Six lanes for traffic

Throughout the length of the work, two 3-lane roadways are provided, separated by a 5-ft. center strip on the parkway at grade and by a 4-ft. strip on the viaducts. Each roadway is 34 ft. wide. On the early contracts this width was made up of a 10-ft. center lane with 12-ft. lanes either side but more recent practice has specified a 12-ft. outside lane and center and inside lanes of 11 ft. each. In Riverside Park, the two parallel roadways are placed at different elevations (southbound roadway at El.+8 and northbound at El.+9.5) to give occupants of the cars an unobstructed view of the river.

Paving is concrete. An 8-in. slab, reinforced top and bottom, is used on parkway at grade. Roadways over the tracks consist of a 7½-in. structural slab covered with a membrane waterproofing, 1-in. of mortar and a wear-

All airviews by Aerial Explorations, Inc.

Fig. 5. Transformation of Riverside Park between 75th and 100th Sts. Left foreground, part of a wading pool. Next above, the three-level grade separation at 79th St. beyond which the highway leaves the roof of the rail subway to follow the riverfront.

ing surface constituting of a 1½-in. top and 2½-in. base of concrete placed monolithically. On the viaducts that are not over railroad tracks a 7½-in. slab is used, with no added wearing surface or waterproofing.

Railroad enclosure

Enclosing the railroad tracks in Riverside Park is one of the major objectives of the improvement, and it has presented some of the major design and construction problems. Virtually, the operation consists of putting the railroad in a subway built on top of the ground and then buried in fill. In general, five tracks have to be covered, requiring a 66-ft. clear width and an 18 ft. clear height for the enclosing structure; at the south end, between 72nd and 74th Sts., where the tracks branch to enter the 60th St. yards, the width increases up to a maximum of 150 ft., and a 22 ft. vertical clearance is required. Some of this enclosing structure is covered with highway, some with earthfill and planting and some with promenade walks, creating a variety of live load conditions. Practically all of it is subjected to side earth pressure. In addition, varying soil conditions and the fact that some foundations were already in place in the 72nd-79th St. area influenced the design. As a result, three different types of enclosing structure are used. Although the details of their designs will be covered in a subsequent article, brief descriptions are pertinent here.

(1) *Precast-beam retaining wall*—When the planning objective was changed from railway enclosure to park and parkway development, it was found that the type of structure that had been designed for track covering was not suitable. This was to consist of a concrete gravity retaining wall along the east side of the tracks, serving as one support for steel girders spanning across the tracks to steel columns which would be hidden by a granite-faced concrete curtain wall rising from 35 to 60-ft. above the park area west of the tracks. This high west wall was particularly objectionable from a park standpoint because it, rather than grass, shrubs and trees, would dominate the scene and because it cut the park into two strips, one high above the other. Proper park development required that the area west of the tracks be filled to the top of the track enclosure, hiding it, and providing a sloping, usable park down to the water's edge.

The retaining wall on the east, from 72nd to 79th Sts., had been built as had the square concrete piers for the steel columns and the curtain wall on the west. It was logical to attempt to salvage this existing construction, but a problem was presented, since the west piers were not designed to resist a side thrust such as would be exerted by a fill against a gravity retaining wall on top of them. After considerable study an ingenious retaining wall of precast concrete beams was developed in which the loads on the foundations are principally vertical and which requires much less material than a gravity wall.

In this design a series of stepped walls was placed transverse to the railway centerline, with their inner ends carried on the existing piers and their outer ends on new pipe piles. These walls were spaced on 17-ft. centers since that was the spacing of the existing piers. Fill was then placed between the walls and allowed to assume its natural angle of repose toward the railroad tracks. Next, precast beams were placed between the stepped walls to provide a solid stepped surface on which the sloping fill could be carried to the top of the wall. Viewed from the railroad track, the structure somewhat resembles a hollow buttress-type dam; from the river side only a sloping earthfill is seen. The unit soil pressure for this particular wall is less than 1 ton per sq.ft. considering the entire base as bearing area; a gravity retaining wall to support such a fill would have exerted a soil pres-

Fig. 7. Stepped deck of precast beams being placed on unique retaining wall of railroad enclosure structure.

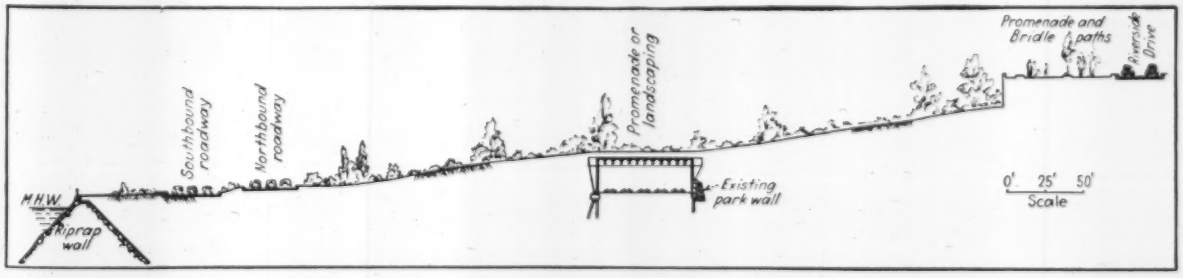


Fig. 6. Riverside Park as reconstructed with the railroad tracks placed underground and a parkway along the river bank. Section is taken at a location where steel rigid frames form the railroad enclosing structure.

sure of 5 tons per sq. ft. at the toe.

With the exception of this west wall, the track enclosure structure in this section (72nd to 79th Sts.) was built according to the original plan, with the highway on the roof.

(2) *Retaining Wall Enclosure*—Beyond 79th St., the highway leaves the railway enclosure, and a type of structure was sought that could be completely buried in fill. Although foundation conditions were not ideal, a conventional gravity retaining wall design was selected. It consists of two walls, spaced 66 ft. in the clear, supported on cast-in-place concrete piles (so spaced that there is an average of 12 piles in each 10 ft. of wall length) and carrying a deck of steel beams and a concrete slab. In some cases this deck is covered with 2½ to 4 ft. of fill, while in others it is used as a promenade.

(3) *Steel Rigid Frames*—The retaining wall enclosure was used as far north as 98th St., where foundation conditions became so poor that some lighter type of structure was desirable. Accordingly, for the section from 98th St. to the end of the track enclosure at about 125th St., a unique steel rigid frame and curtain wall structure was finally developed, which proved unusually easy to build and showed considerable economy, particularly in the foundations which consist of three piles under each leg, one pile being inclined to resist the unbalanced horizontal component of the frame reaction. This rigid frame design required only a small percentage of the piles which would have been necessary for a gravity-type wall.

A total of 363 frames of 66 ft. clear span, spaced 17 to 20 ft. apart, were designed for this section. The frames are connected by 12-in. I-beam stringers on 5 ft. centers supporting a concrete slab roof. Concrete sidewalls in the plane of the inner flange of the legs complete the enclosure structure which will be buried in earthfill; in some places the roof will be covered with from 2½ to 4 ft. of earth while in others it will be used as a promenade. The frames are unusual in that the east leg is considerably shorter than the west leg since the east footing is in the form of a concrete wall high enough to accommodate the electrical conduits necessary for railroad operation. (Figs. 1 and 6).

The frames are of the square-knee type in which the girder, with a straight bottom flange, rests directly on the legs. With a few exceptions all frames are of silicon steel, since the resulting shallow girder construction and the consequent lighter loads give this material an economic advantage over carbon steel.

Viaduct Structure

The viaducts which are required at a half dozen points along the 7 miles between 72nd and Dyckman Sts. are of a variety of types to suit local conditions. As in the case of the railroad enclosure, these viaduct designs will be covered in a subsequent article, but a few of their salient features may be cited.

At 72nd St. where a transition section of viaduct was required to connect the West Side elevated highway with the highway on top of the railroad enclosure, a series of semicircular solid-web steel arches was selected. Since the structure is quite high and on a skew, it was considered that an arch would have a better appearance than a girder. Of 40 to 45 ft. span, the arches, of hingeless design, spring from the tops of the steel columns on the bents which range in height up to 30 ft. The deck is carried on floorbeams resting on short steel columns set on top of the arch ribs.

At 79th St., a three-level grade separation structure furnished a most unusual, viaduct-framing problem. In order that 79th St. traffic can enter the parkway southbound and that southbound traffic on the parkway can connect with 79th St., it was necessary to extend 79th St. beneath the parkway, and over the railway. Inasmuch as 18-ft. clearance is required for the railway and 14 ft. for the highway, a fill nearly 45 ft. high would have been required west of the parkway to accommodate the necessary ramps, which also must give access to a boat basin on the waterfront. Such a heavy fill was not advisable so close to the river and in addition studies indicated that it would be more economical to build structural steel supports for the roadways than to provide the fill with its necessary retaining walls. The adopted structure is elliptical in plan (250 ft. wide by 300 ft. long) and, it not only serves as a roadway support, but also accommodates a parking garage for 175 cars on its lower level. At an intermediate level is a large fountain around which is arranged a promenade and a river lookout. In reality the structure is a steel frame building carrying roadways on the roof and with the areas between the roadways covered with fill and landscaped. The exposed concrete walls are faced with a rubble granite. The many warped surfaces necessary on this structure to fit the roadway grades made its framing details unusually complicated.

Fig. 8. Three-level grade separation in which 79th crosses on the intermediate level to the elliptical ramp structure (illustrated on the cover) whose foundations are under way in the foreground.

Two types of viaduct are used in

the 16-block section between St. Clair Place and 145th St. For the south-half of this section a series of three-span continuous girders has been designed. Two lines of girders with curved lower flanges are used, spaced 54 ft. apart; the deck cantilevers 12 ft. on either side to give the full 78-ft. width. The columns run through to deck level, and girder continuity is obtained by tension ties across the tops of the columns and compression fills between the column flanges at the level of the lower flange of the girders. Foundations for this continuous girder viaduct, consist of steel-pointed pipe piles driven to firm bearing.

The north-half of this viaduct section traverses railroad yards, and here the span lengths had to be varied to clear existing tracks. Under such circumstances, continuous design was not practicable, and simple girder spans are used. The bents are about 70 ft. wide between columns and are connected by five lines of stringer girders.

The record-breaking plate girder at 158th St., where the highway crosses the railroad, has already been mentioned. Of 190-ft. span, it will be located in the west face of the viaduct. No companion girder will be used on the east, the transverse floorbeams spanning from the girder across the tracks to columns on the east right-of-way line. The girder is to be fabricated of silicon steel, and its ⅝-in. web is 126 in. deep. One end of the girder is pinned while the other end is on a rocker. It will be erected in two pieces, with a splice at the center.

The remainder of the viaduct, at the George Washington Bridge and beyond, is of conventional sidehill type, that is, bents consist of girders spanning between a steel column on the downhill side and a short concrete pier on the uphill side. Double supports are used at every second pier for expansion purposes. Near Dyckman St. where the highway is over the railroad, some 70 ft. wide bents are used, the highway occupying only the east half of them. Finally, the Dyckman St. crossing at the extreme north end of the line is effected by a two-span (93–109 ft.) continuous girder bridge.

Sometime this Fall the highway will be opened to traffic, and this unusual collection of interesting engineering structures will begin to serve the purposes for which they were designed. The railroad in Riverside Park will cause no more inconvenience than the one which now rumbles unnoticed beneath Park Ave. The express highway will provide motorists with an effective bypass around and over Manhattan's congested streets. And the new facilities in Riverside Park will furnish citizens of all ages with new active play areas and suburban greenery. New York City will have completed one of its most important public improvements—reclamation of its Hudson River waterfront. And it will have completely transformed transportation facilities that were inefficient, inadequate and unsafe.

Personnel

Madigan-Hyland and the engineering department of the New York Central Railroad acted as design and supervising engineers. The principle personnel follows:

City Park Department—
- Robert Moses, commissioner
- Allyn R. Jennings, general superintendent
- William H. Latham, park engineer

Madigan-Hyland—
- E. H. Praeger, chief engineer
- E. L. Pavlo, assistant chief engineer
- G. D. Clarke, landscape architect
- C. F. Loyd, architect

N. Y. Central R.R.—
- R. E. Dougherty, vice president
- J. W. Pfau, chief engineer
- J. M. Doorly, engineer of N. Y. terminal district

New York State Transit Commission—
- William C. Lancaster, chief engineer

Principal Contractors

Section	Location	Contractor
1	72nd to 76th	Poirer & McLane
2	76th to 79th	Frederick Snare
3	79th to 83rd	James Stewart
4	83rd to 94th	Poirer & McLane
5	94th to 98th	P. T. Cox
6	98th to 111th	Del Balso
7	111th to 121st	James Stewart
8	121st to 124th	Poirer & McLane
9	St. Clair Pl. to 135th	P. T. Cox (Fnd.) G. F. Driscoll (Fnd.)
10	135th to 146th	Geo. J. Atwell (Fnd.) P. T. Cox (Viaduct)
11	146th to 178th	Poirer & McLane
12	171st to Dyckman St.	Del Balso (Walls) Duffy (Viaduct)
Track Enclosure Steel		
	72nd to 83rd	American Bridge Co.
	83rd to 98th	Bethlehem Steel Co.
	98th to 121st	American Bridge Co.

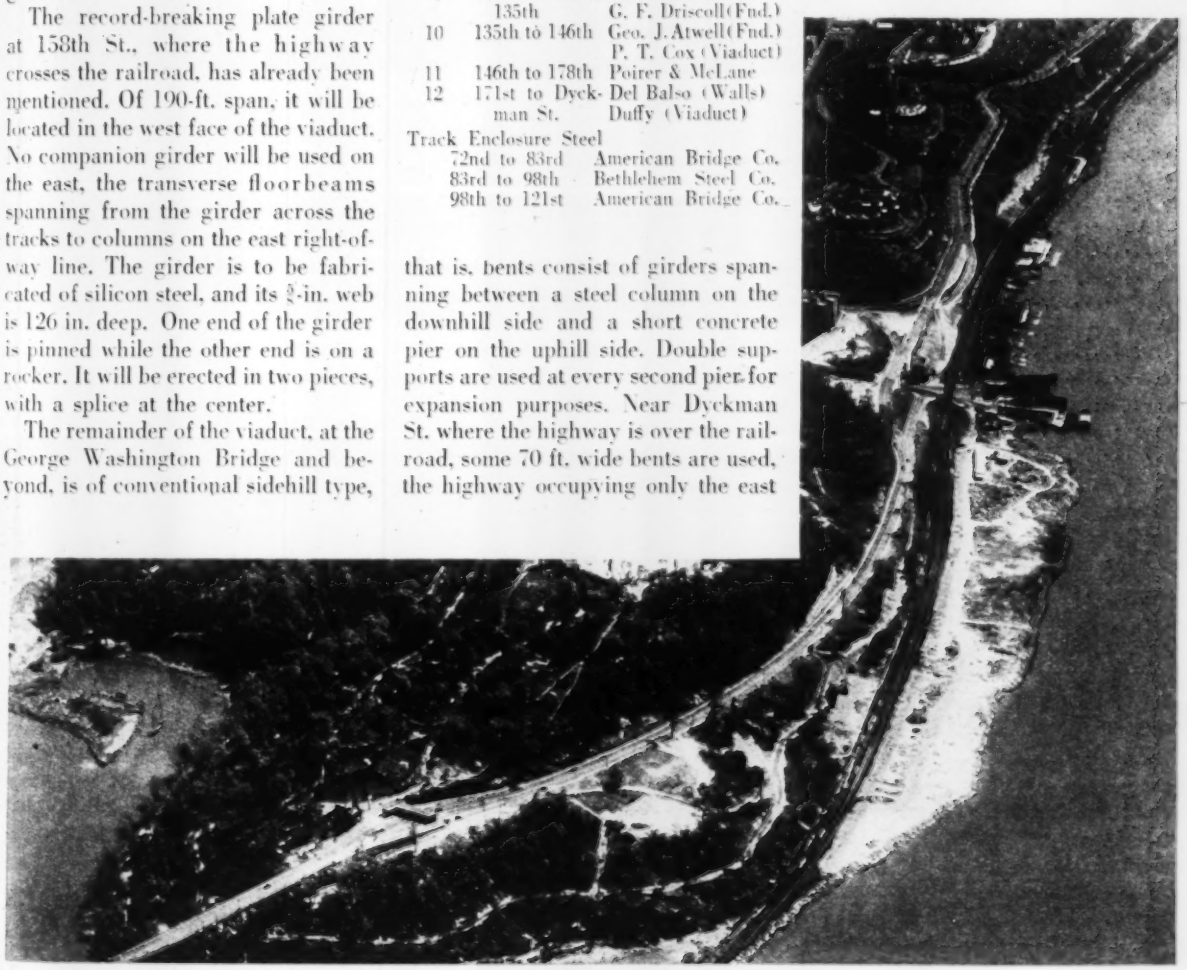


Fig. 9. Henry Hudson Parkway curving through Inwood Park to the Dyckman St. connection (at the river piers). Grade for the new parkway in Fort Washington Park is shown halfway up bluff, in upper right corner of view.

Putting Skid Resistance Into Roads

Construction methods that produce skid-resisting surfaces and maintenance methods that reduce ice and mud hazards

Slippery roads exist because of improper construction and inadequate maintenance. Any road can be made skid-resistant and kept in that condition. A "Slippery Road" sign is a confession of faulty construction or upkeep. These are the lessons of the report of the problem committee on road surfaces, headed by R. A. Moyer, associate professor of civil engineering, Iowa State College, to the committee on safe highways of the American Road Builders Association. Reviewing the accumulated results of laboratory and field tests of skid resistance Prof. Moyer outlines the following practicable processes for producing skid-resistant surfaces and reducing the hazards of ice and mud.
—EDITOR

ALL tests and field observation indicate that skid resistance can be built into road surfaces of any type. The greater hazard of snow, ice and mud can be largely reduced by maintenance. In most cases the methods are simple; they can be stated in very brief terms.

Concrete

Concrete surfaces may be made skid resistant by brooming the surface or by finishing it with a canvas belt; the brooming or belting operation brings the sharp sand grains to the surface and removes or breaks up the coating of cement paste which is responsible for the slippery condition that is certain to develop on concrete surfaces finished with a steel trowel. The use of a liberal amount of clean sharp hard sand in the mix, even leaning toward an over-sanded mix, improves skid resistance. Excessive manipulation, vibration or finishing draws an excess of cement paste to the surface and is certain to contribute to slipperiness. Application on the surface of the green concrete of corundum, carborundum, emery recrush, ganister or similar abrasives which are considerably harder and more wear resisting than the cement or aggregate constitutes a method of treatment that is known to be very effective on concrete stairways and offers a possibility in building a more permanent skid-resistance into our concrete roads.

Black top

It is possible to build blacktop surfaces that are as free from the dangers of skidding as any road surface in common use today, and with the information now at hand there is no reason why every mile of bituminous road can not be made safe against the hazard of skidding. An examination of bituminous surfaces found to be slippery reveals that they are covered with heavy seal coats having an excess of bituminous material. The surfaces that offer high resistance to skidding are covered with sharp, hard sand, or with hard and finely crushed rock particles, held in place by the weaker bituminous cement. As the tops of the sand or rock particles are uncoated with bitumen, these surfaces may be said to have a sandpaper-like finish, renewable under the action of traffic and weathering. It should be recognized that excess tar or asphalt in a bituminous mixture is not only certain to cause a slippery surface in hot weather but is also likely to cause the surface to be unstable and to creep or shove and to form ruts under the action of traffic.

Cutback oils

Certain cutbacks of the slow, medium or rapid curing type appear to cover the aggregate in thinner and stronger films than straight oil asphalts or asphalt cements. Those thin films wear off faster, especially on hard non-absorptive aggregates, than the thicker films obtained with the heavier oil asphalts, and therefore cutbacks can be expected to develop higher skid-resistance.

Bituminous surfaces that are glazed over with excess asphalt and are known to be slippery may be improved by applying heated sand or screenings or rock chips uniformly over the surface and rolling the surface with a moderately heavy roller. Another possibility is cutting back the excess asphalt with a volatile solvent such as kerosene or a fuel oil distillate, then applying the cover material to blot up the excess binder and again rolling. While limestone dust is very effective in drying up oily surfaces or in blotting up the excess asphalt and in stabilizing the surface, it lacks the grittiness that sand or the coarser screenings and rock chips can give the surface to make it highly skid resistant. Large stones, which develop a surface with a rough-knobby finish, are not as satisfactory as a gritty sandpaper finish.

Bridge floors

Certain surfaces, such as wood plank, smooth steel traffic plates and ordinary asphalt plank, are found by test to be as slippery when wet as icy surfaces. These materials are generally used on bridge floors, where skidding accidents are far more dangerous because of the restricted roadway. They are so slippery that they should not be used under any conditions on our highways unless they are provided with some type of gritty surface finish. The wood plank may be covered with a bituminous treatment and suitable sand or stone cover material. The steel traffic plates should have a stud or grid design providing sharp edges which will grip the tire and prevent skidding. The surface of the ordinary asphalt plank should be covered with sharp aggregates which may be rolled or pressed into the plank to form a rough-textured gritty finish.

Recent developments in the manu-

facture of paving brick and in brick pavement construction have greatly improved the skid resistant properties of brick pavements.

Brick

The modern de-aired vertical-fiber paving brick with lugs provides a wear-resisting gritty surface finish. Where there is any difficulty in obtaining the gritty finish, it is possible to face the surface of the brick with corundum, carborundum or emery grits during manufacture and thereby provide a permanent wear-resisting and skid-resisting surface which is the equal of any other material.

Bleeding at the joints has been practically eliminated by using a blended asphaltic joint filler mixed with a mineral flour to provide a stable mix with a low coefficient of expansion. Also the brick surface is sprayed with a calcium chloride solution composed of 35 per cent calcium chloride, 1 per cent starch and 64 per cent water. By this method the surplus asphalt may be scraped and peeled off the surface after it has cooled and hardened, leaving a clean surface with flush-filled joints. Brick surfaces with excess asphalt may be treated with sand or similar cover material to blot up the extra asphalt, using a method similar to that described in connection with the treatment of slippery bituminous surfaces. Traffic will eventually wear off the excess asphalt and expose the clean brick, but skidproofing the surface will hasten this process and will provide a high resistance to skidding in the meantime.

Gravel and stone

Sand, gravel, cinders or macadam surfaces can provide a uniformly high resistance to skidding in the wet or dry condition, providing the surface is firm and reasonably free from loose material. Loose aggregates, especially sand and gravel pebbles, act as ball bearings under the tires, causing variations in the skidding resistance which make it difficult to steer and cause many accidents. These surfaces should be stabilized with clay or oil or with a similar binder that will prevent the loose condition. The loose condition creates another hazard—the dust hazard, which interferes with visibility. It also increases fuel, tire, car repair costs and road maintenance costs. Engineers and road officials should realize that untreated surfaces are expensive, dangerous, and take much of the pleasure out of driving for the present-day motorist.

The results of tests on mud-, snow-, and ice-covered surfaces clearly indicate that they constitute the most uniformly hazardous road conditions that the motorist is likely to encounter. Ice and sleet are found to be particularly slippery, providing a frictional resistance only about one-tenth as great as that provided by a dry concrete surface. A driver venturing out on a freshly formed icy surface with a car not equipped with tire chains is inviting all kinds of trouble. The crown of the average city street introduces enough slope to cause the car to slide into the curb unless the driver can straddle the crown line. The car can not climb a long grade steeper than 3 or 4 per cent, and will be very likely to slide down, completely out of control, on grades steeper than 5 per cent. The seriousness of the snow and ice problem is indicated by the fact that about 80 per cent of all skidding accidents in Iowa were found to occur in the four winter months.

Slippery conditions

The correction of this slippery condition is clearly a maintenance problem and demands prompt attention if it is to be effective. Ice forms at temperatures close to the freezing temperature, and if sand or cinders are applied on the surface promptly at this time the sand and cinders will be imbedded in the ice. If the application of the sand or cinders is postponed until much lower temperatures prevail, the sand or cinders will not be imbedded and the wind and traffic will whip them off the road. If the stockpiles of sand or cinders are treated with a solution of calcium chloride (20 to 50 lb. per cu.yd. of sand or cinders) imbedding of the sand or cinders so treated may be accomplished at temperatures considerably below freezing. In certain states, notably in Michigan, calcium chloride and sodium chloride have been applied directly on the icy surfaces. It has been found that such treatment of ice on portland cement concrete surfaces causes serious damage to the concrete in the form of scaling and a gradual disintegration of the concrete. For this reason the Portland Cement Association advises against the use of sodium or calcium chloride and recommends that the sand or cinders be heated before being applied.

Snow

Snow, especially dry snow, has two or three times the skid-resistance of ice. However, the transition from snow to ice may be made so easily that the driver has no assurance that the snowy surface is free from ice. Therefore maintenance men should lose no time in applying sand and cinders at all intersections, on hills and on curves as soon as the snow becomes packed. Traffic will assist in the imbedding process, and if the temperature is close to the freezing point, so that the snow is likely to change to ice in the traffic lanes, the prompt application of sand or cinders before this transition takes place will make its imbedding into the surface more satisfactory. Black cinders are imbedded more readily when the sun shines than the lighter colored sand, because the cinders absorb the heat of the sun. With the increased travel during the winter and the increased demand for all-weather highway transportation service that is evident today, maintenance engineers must plan to act promptly to meet the emergency of slippery road conditions created by ice and snow. The task is complicated by the fact that the use of many aids to thawing action carry the hazard of surface disintegration.

Mud

A skidding menace that is the cause of many accidents on rural pavements is the presence of mud on pavements. The mud is either splashed onto the pavement from the shoulder when a car runs into the rut that frequently forms adjacent to the pavement, or when the car runs out on the shoulder, or it is tracked onto the pavement from muddy side roads, farm drives or field entrances. On important roads the writer recommends that the shoulders be surfaced with gravel, cinders, or crushed rock for a width of 8 or 10 ft. Not only would the mud hazard be eliminated in this way but shoulders could then be used to good advantage as a traffic lane when ice or sleet is forming on the pavement. The tracking of mud onto the road at intersections can be prevented by surfacing all these approaches with gravel or the like over a distance of 50 ft. or more from the pavement.

Sanitation Stirs the South

by E. J. CLEARY
Assistant Editor, Engineering News-Record

Widespread activity in sanitation below the Mason-Dixon line mirrors the influence of economic change, progressive growth and insistent public demands for adequate facilities to meet new needs

NO OTHER section of the country today can boast of a more vigorous and varied sanitary engineering improvement program than that being promoted in the region south of the Mason-Dixon line. From the construction of major sewage disposal plants in metropolitan centers and the installation of standard privies in rural areas (91,000 completed in one state alone!), to intensive mosquito control campaigns and stream pollution abatement measures, there is brisk activity in every type of sanitation endeavor. Cities, counties and state agencies, in many cases accelerated by federal aid, are all busily engaged in this work.

To understand the reason for this activity we must first picture the South against a background of industrial growth. Here is a region, once dominated entirely by agricultural pursuits, being metamorphosed by pulsations of machines and the restless hum of expanding centers of population. The economic and social changes resulting therefrom have brought many new problems, among which sanitation ranks foremost.

Time and change

The influences of change gather momentum slowly, and it is often difficult to perceive their effects until suddenly it becomes apparent that powerful forces are at work. This is the situation in the South today. The widespread sanitation program cannot be regarded as something of recent or spontaneous origin, but rather is the resultant of growth that compels the provision of adequate facilities to meet new needs.

It is natural therefore, that considerable attention should be given in urban centers to water supply and to the disposal of sewage and refuse. At the same time broader emphasis is being placed on the solution of rural health problems—particularly malaria control. Intensive mosquito abatement measures are under way in almost every county in a determined campaign to reduce the toll of malaria, which in the Mississippi Valley alone is estimated to cause 10,000 deaths a year.

One other factor of considerable importance, one that made possible the recent fruition of many plans and projects, is the availability of federal financial aid—either in the form of PWA loans and grants or through WPA projects. But it is a helpful influence rather than the motive cause of the sanitary improvement; continued active progress in sanitation is to be expected even when federal aid comes to an end. The increasing influx of industries, the continued betterment of municipal finances, and ever-widening public enthusiasm and demands, are some of the powerful accelerating influences which will work to this end.

Fig. 1. Atlanta's sewage disposal project involves a comprehensive layout of sewers, installation of five new treatment plants and the enlargement of an existing plant.

Atlanta's program

A tour through the Southern states everywhere gives visual evidence of the trend. At Atlanta, for instance, a $6,000,000 extention of sewage disposal facilities is under way, financed with PWA, WPA, city and county funds. The

project includes construction of about 60 mi. of sewers and of five treatment works, and the remodeling of an existing trickling filter plant. Clarke Donaldson and William A. Hansell, chief and assistant chief of construction, respectively, are guiding this work.

As is true elsewhere, enlargement of Atlanta's facilities in the past has not kept pace with growth. Since the 1911-13 period, when three Imhoff tanks and sprinkling filters (total capacity 16 m.g.d.) were installed, the city has almost doubled in size. In 1930 an improvement plan was made, but actual work was not started until 1934, when six miles of sewers were laid with the aid of PWA funds. Each year since then additional sewers have been laid, up to 90 in. in size, and this part of the improvement project is nearly half completed.

New plants projected

Two of the original treatment units will be abandoned, the Intrenchment Creek plant will be enlarged from 5 to 14 m.g.d., and five new plants are projected—Clayton, South River, Utoy, Eagan and Beaver River. Topographic conditions made it cheaper to build several individual plants than a central disposal works, which would have required the construction of costly intercepting sewers.

The 40 m.g.d. Clayton plant, costing about $780,000, is the largest in the group. It will take the place of the old Peachtree (8 m.g.d.) and Proctor Creek (3 m.g.d.) plants, now heavily overloaded. Treatment will include sedimentation, with chemical precipitation during three months of the year, sludge digestion and vacuum filtration. Sludge gas is to be used as fuel in three gas engines, whose combined capacity is 180 hp. The consulting engineers on this job are Wiedeman & Singleton of Atlanta. Work was started in the fall of 1936 and the project is about 25 per cent completed.

Remodeling work on the Intrenchment Creek plant, costing about $490,000, consists of converting Imhoff tanks into straightline filters, and adding a magnetite filter for final clarification. Sewage digestion gas will be used to operate two engines totaling 120 hp. Raw sewage is to be treated with chlorinated copperas. An interesting feature will be burning of sludge gas to furnish CO_2 which is to be introduced into the sewage for pH adjustment during periods of high causticity caused by bleachery wastes. Wiedeman & Singleton are the consultants also on this job; it is now about 75 per cent completed.

The South River plant, capacity 6 m.g.d., is a trickling-filter installation on which construction was begun in the fall of 1936. Sludge will be digested and dried on sandbeds. Robert & Co. of Atlanta are the consulting engineers for this work, which is estimated to cost $300,000. At the Utoy plant (3 m.g.d.) sedimentation, sludge digestion and drying beds will be employed. Work was started on this $90,000 job last December; the J. B. McCrary Engineering Corp. is consultant. The remaining two plants, Eagan and Beaver Creek, small units of 0.5 and 9.2 m.g.d. in which complete treatment and separate sludge digestion will be used, have not yet been started.

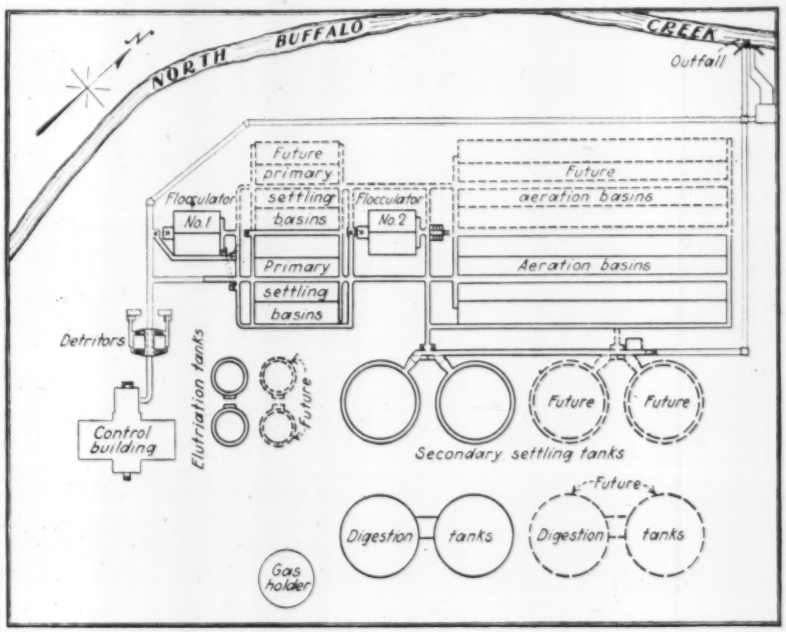


Fig. 2. Greensboro's sewage disposal plant is designed for high degree of treatment and flexibility in operation. Sludge will be digested and then elutriated prior to dewatering on vacuum filters.

Greensboro makes improvements

One of the most interesting of the new sewage projects is the 6.5 m.g.d. plant now under construction at Greensboro, N. C. It incorporates features representing the most advanced thinking in equipment, layout and treatment processes. C. W. Smedberg, director of public works and former consulting sanitary engineer, pointed out that the plant was designed to provide the utmost flexibility both in operation and adaptation to various methods of treatment. This was considered necessary in view of the fact that the plant will receive more than a million gallons a day of industrial wastes from large textile mills in the city. It is expected that by experimentation a special treatment technique can be devoted to handle this load along with domestic sewage.

The plant is of the activated-sludge type and includes, in addition, a flash mixer and flocculator equipment for chemical pre-treatment. The layout is such that sewage can be passed to the settling tanks with or without chemical additions, and the four rectangular settling basins may be operated either in parallel or in series. After primary sedimentation the sewage can be bypassed into the outfall channel when the aeration tanks are not operating. Incoming raw sewage can also be bypassed to the receiving stream after it has gone through the screening comminutors and detritors. The latter are of sufficient size to take care of flows up to 13 m.g.d.—twice the capacity of other units in the plant.

Sludge elutriation

Sludge will be digested and then elutriated prior to being dewatered

in vacuum filters. The digestion tanks have floating covers to facilitate the collection of gas, for whose storage a 30,000-cu.ft. holder is to be built. The gas will operate two gas engines connected to an electric generator. Three centrifugal blowers, each with a capacity of 1,750 cu.ft. per minute, will supply air for the activated-sludge process. Provision has been made for enlarging the sedimentation, aeration and elutriation units later on. The consulting engineer on this job (Buffalo Creek project) is William B. Olsen of Raleigh. The new plant will supplement an existing 3½ m.g.d. trickling filter and separate sludge digestion installation made several years ago and now heavily overloaded.

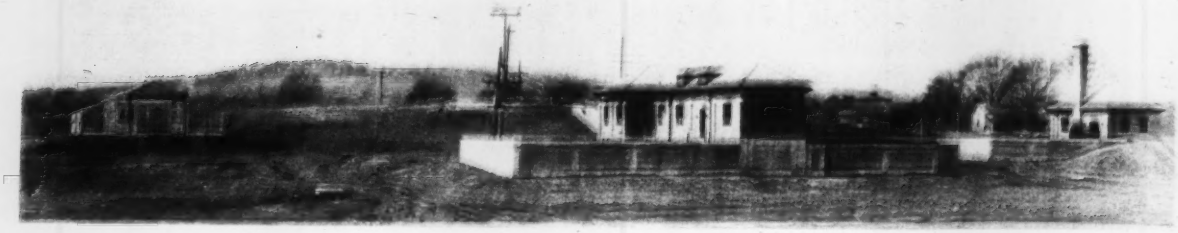


Fig. 3. Chattanooga built this 1 m.g.d. activated-sludge disposal plant to serve a rapidly expanding section of the city. Growth increase, however, has not yet been sufficient to justify operation.

Believe it or not!

While it a common thing to learn that communities with sewage treatment plants soon find them overloaded because of rapid population increases, Chattanooga, Tenn., has the unique distinction of possessing a complete disposal plant ready for use as soon as sufficient connected flow justifies operation.

The story is that in 1928-29 the eastern section of Chattanooga, separated by a ridge from the main part of the city, had grown so rapidly that further increase in population threatened serious pollution of Chickamauga Creek. Since it was topographically impracticable to connect this area with existing city services (which discharge into the Tennessee River, where adequate dilution is available), the city fathers decided on the construction of a separate disposal plant, using a 1 m.g.d. activated-sludge treatment unit. This was completed in 1930. By that time, however, the economic depression had already curtailed home expansion in the area, and consequently there has never been sufficient flow to warrant operation of the plant.

Memphis seeks improvement

Memphis also is thinking seriously about sewage disposal. For many years sewers have been discharging into Wolf Creek, a tributary of the Mississippi River in the northern part of the city. Occasionally, at times of low summer flow, the odors from this waterway are so bad that serious complaints come from the downtown business section, some distance away. A report on the problem by Black & Veatch, Kansas City, recommended among other things the construction of intercepting sewers to convey the sewage to a point below the city, where it could be discharged directly into the Mississippi without nuisance.

State-wide activity

Indicative of state-wide progress in the installation of sanitary facilities are the following facts: The Tennessee Department of Health lists sewer systems in 93 communities, 50 of which are provided with some form of treatment. Under the PWA program during the last two years preliminary plans were approved by the department for 18 new sewer systems, final plans were passed for 11, and improvements to existing works were approved for 7 towns. In Kentucky during the last two years there has been a big increase in the number of sewage disposal plants. At the present time about 40 plants, most of which afford primary treatment only, are in operation.

North Carolina is making progress in promoting the betterment of water supply and sewage disposal facilities, with particular attention centering on towns and rural areas. Most of the larger communities in the state are now provided with good water systems, and within recent years small villages in the 400-500 population class have been stimulated to build treatment plants and distribution systems. Interest in sewage disposal is accelerating largely because of stream pollution difficulties. The major cities, with the exception of Raleigh, have modern treatment plants.

The sanitary division of the state health department, under the direction of Warren Booker, is sponsoring an important program of privy construction in rural sections. Since 1935 more than 91,000 standard units have been constructed and distributed at the rate of 650 per week. About 1,000 men supplied by relief agencies are employed on this work, which is handled by county health supervisors. Privies are supplied to anyone who will pay for the material used in the construction—about $11. The labor cost per unit, which includes preparing lightweight concrete risers and slabs and general erection, amounts to $13.50. A standard design is used.

Septic tanks are widely used by residences and institutions in North Carolina; the health department furnishes free plans and advice on their construction to architects and builders. A capacity of 300 gal. per 6 people is recommended; approval is not given to any installation with a capacity of less than 500 gal.

Refuse disposal practice

Although many towns and cities in the South are provided with means for refuse disposal, principally incinerators, the refuse problem is claim-

ing considerable attention. In a number of places collection services are in the process of modernization, with the result that mule-dawn carts are rapidly being supplemented by specially-equipped motor trucks.

Something new in refuse incineration is being put to practical trial by Henry Cates, chief of the sanitary department of Atlanta. He has rigged up a 10-ton hammermill grinder at the city incinerator to reduce garbage and rubbish to a uniform size (passing 1-in. sieve), and in this form the material will be blown into the furnaces with preheated air. Complete tests have not yet been made, but it is expected that the scheme will increase combustion efficiency by 25 to 45 per cent. This is an important item because steam is generated from waste heat at the Atlanta incinerator. Last year 150,000,000 lb. of steam was sold (at 20 cents per 1,000 lb.) for heating public buildings and offices in the downtown area. The steam sales net a return sufficient to reduce disposal costs by about 40 per cent.

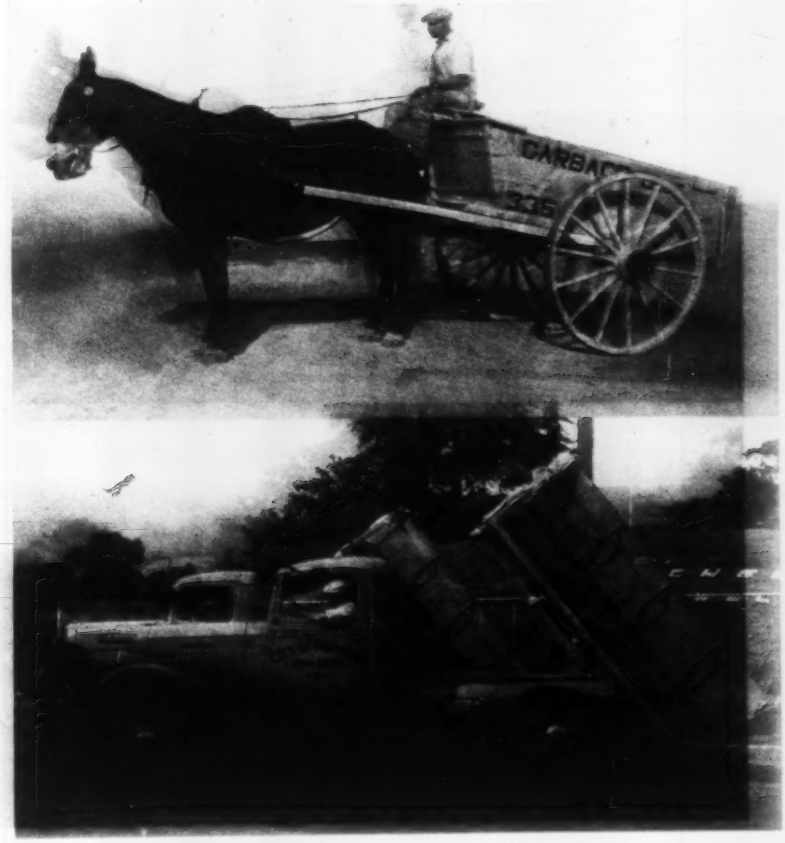


Fig. 4. Refuse collection methods have been modernized in the interests of efficiency in Southern cities.

Textile waste treatment

Wide concern is felt among southern sanitary authorities over the problem of stream pollution—complicated in this section of the country by the great number of textile mills that discharge their wastes untreated. Most communities, wisely recognizing the economic benefits resulting from the location of these mills within their boundaries, are willing to treat the industrial wastes in their municipal plants. However, this has not solved the problem, for the reason that ordinary sewage disposal processes are not necessarily adapted to the treatment of textile wastes—whose composition and type are almost infinite in number. Mill owners have been awakened to their responsibility in the matter because of the increasing number of water-pollution damage suits that have been decided against them by the courts. Black sulphur dye wastes are particularly offensive; they not only color the water course into which they are dumped but also create bad odors by release of hydrogen sulphide gas.

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Stream pollution abatement

But textile waste treatment is not the only problem receiving attention in connection with stream pollution abatement. Curtailment of acid mine drainage is also under way in several places. In Kentucky, for example, F. Clarke Dugan, state sanitary engineer, estimates that abandoned coal mines are daily pouring about 4,500,000 lb. of acid sulphur water into streams. With the aid of federal funds and the cooperation of mine operators, some 4,600 abandoned mines have been located, of which 600 have been sealed during the last three years. The practicability of mine-sealing as a correction for this form of acid pollution was demonstrated fifteen years ago by the U. S. Engineers Corps and later by the U. S. Bureau of Mines. Much work of this type has been done in West Virginia, Pennsylvania and Ohio as well.

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in vacuum filters. The digestion tanks have floating covers to facilitate the collection of gas, for whose storage a 30,000-cu.ft. holder is to be built. The gas will operate two gas engines connected to an electric generator. Three centrifugal blowers, each with a capacity of 1,750 cu.ft. per minute, will supply air for the activated-sludge process. Provision has been made for enlarging the sedimentation, aeration and elutriation units later on. The consulting engineer on this job (Buffalo Creek project) is William B. Olsen of Raleigh. The new plant will supplement an existing 3¼ m.g.d. trickling filter and separate sludge digestion installation made several years ago and now heavily overloaded.

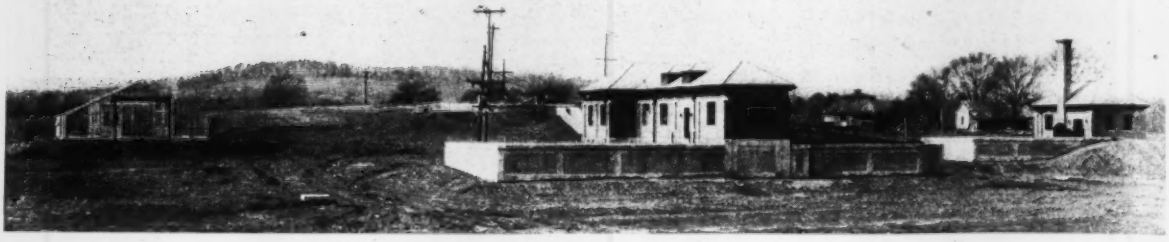

Fig. 3. Chattanooga built this 1 m.g.d. activated-sludge disposal plant to serve a rapidly expanding section of the city. Growth increase, however, has not yet been sufficient to justify operation.

Believe it or not!

While it a common thing to learn that communities with sewage treatment plants soon find them overloaded because of rapid population increases, Chattanooga, Tenn., has the unique distinction of possessing a complete disposal plant ready for use as soon as sufficient connected flow justifies operation.

The story is that in 1928-29 the eastern section of Chattanooga, separated by a ridge from the main part of the city, had grown so rapidly that further increase in population threatened serious pollution of Chickamauga Creek. Since it was topographically impracticable to connect this area with existing city services (which discharge into the Tennessee River, where adequate dilution is available), the city fathers decided on the construction of a separate disposal plant, using a 1 m.g.d. activated-sludge treatment unit. This was completed in 1930. By that time, however, the economic depression had already curtailed home expansion in the area, and consequently there has never been sufficient flow to warrant operation of the plant.

Memphis seeks improvement

Memphis also is thinking seriously about sewage disposal. For many years sewers have been discharging into Wolf Creek, a tributary of the Mississippi River in the northern part of the city. Occasionally, at times of low summer flow, the odors from this waterway are so bad that serious complaints come from the downtown business section, some distance away. A report on the problem by Black & Veatch, Kansas City, recommended among other things the construction of intercepting sewers to convey the sewage to a point below the city, where it could be discharged directly into the Mississippi without nuisance.

State-wide activity

Indicative of state-wide progress in the installation of sanitary facilities are the following facts: The Tennessee Department of Health lists sewer systems in 93 communities, 50 of which are provided with some form of treatment. Under the PWA program during the last two years preliminary plans were approved by the department for 18 new sewer systems, final plans were passed for 11, and improvements to existing works were approved for 7 towns. In Kentucky during the last two years there has been a big increase in the number of sewage disposal plants. At the present time about 40 plants, most of which afford primary treatment only, are in operation.

North Carolina is making progress in promoting the betterment of water supply and sewage disposal facilities, with particular attention centered on towns and rural areas. Most of the larger communities in the state are now provided with good water systems, and within recent years small villages in the 400-500 population class have been stimulated to build treatment plants and distribution systems. Interest in sewage disposal is accelerating largely because of stream pollution difficulties. The major cities, with the exception of Raleigh, have modern treatment plants.

The sanitary division of the state health department, under the direction of Warren Booker, is sponsoring an important program of privy construction in rural sections. Since 1933 more than 91,000 standard units have been constructed and distributed, at the rate of 650 per week. About 1,000 men supplied by relief agencies are employed on this work, which is handled by county health supervisors. Privies are supplied to anyone who will pay for the material used in their construction—about $14. The labor cost per unit, which includes precasting lightweight concrete risers and slabs and general erection, amounts to $13.50. A standard design is used.

Septic tanks are widely used by residences and institutions in North Carolina; the health department furnishes free plans and advice on their construction to architects and builders. A capacity of 800 gal. per five people is recommended; approval is not given to any installation with a capacity of less than 500 gal.

Refuse disposal practice

Although many towns and cities in the South are provided with means for refuse disposal, principally incinerators, the refuse problem is claim-

ing considerable attention. In a number of places collection services are in the process of modernization, with the result that mule-dawn carts are rapidly being supplemented by specially-equipped motor trucks.

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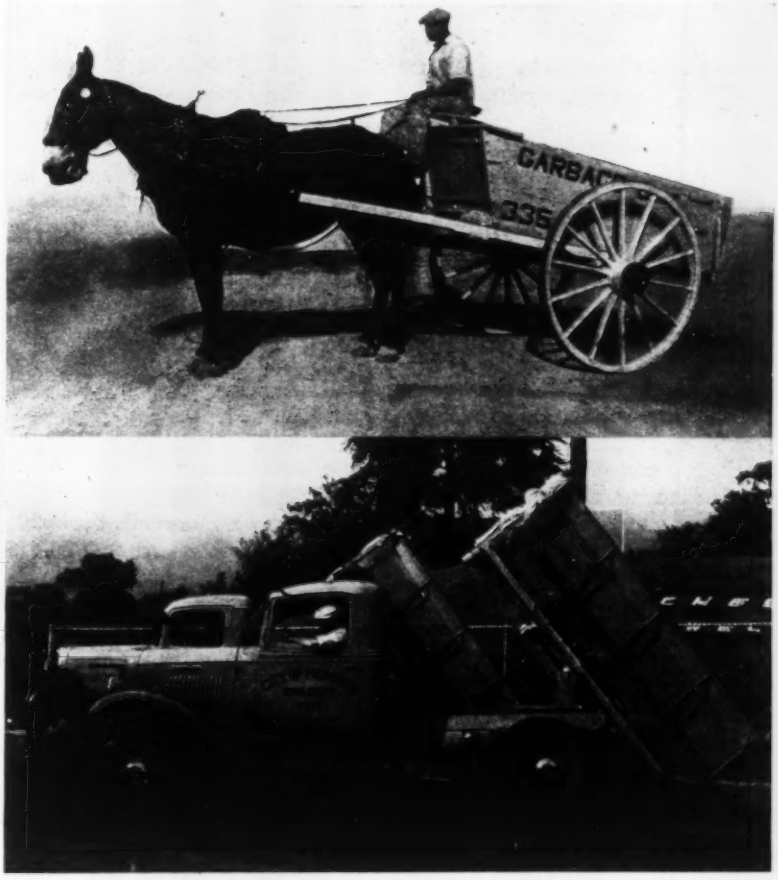

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pounded waters, the distribution of larvicides and screening of houses are the common control methods. Millions of dollars are spent on control measures. Not only are state, county and city agencies engaged in this work, but power companies, railroads and other industries carry on equally active programs in order to maintain the efficiency of their employees and minimize costly turnover of labor.

Perhaps the most striking demonstration of regional malaria control work is that furnished by the Tennessee Valley Authority's work. A board of consultants, each member representing a particular aspect of malaria work, is working with the authority to plan measures and secure coordination of various agencies so as to prevent mosquito production along the 2,300 miles of impounded reservoir shorelines. The design of Wheeler Dam, for instance, was changed to provide alterations in the height of the gates so that periodic fluctuation of water levels could be brought about to keep the shorelines clean. Other measures undertaken by the TVA include drainage of swamp areas, removal of brush and floatage from reservoirs, regular larvicide dusting by airplane, mosquitoproofing of homes and general health education.

Control in a city

Located in the heart of the Mississippi Valley's malaria belt, Memphis, like many other southern cities, rightly considers mosquito abatement one of its major health activities. A. H. Fletcher, engineer in charge of the bureau of sanitation of the city's health department, has been conducting an effective campaign for many years. A 10-day oiling schedule on all catchbasins, bayous and water courses is maintained during the breeding season; in addition permanent drainage ditches (now totaling 178 miles) have been installed throughout low-lying areas in the city.

Federal relief funds have made available the services of several hundred men during the past three years, and much valuable work is being done in straightening ditches and lining them with concrete or riprap. One of the most troublesome problems of abatement work, says Mr. Fletcher, is to secure the cooperation of home owners in caring properly for garden fish ponds; these pools are excellent breeding places for the malaria-transmitting mosquito.

A veteran assists

Assisting in the Memphis program, as well as guiding malaria control activities throughout the Mississippi Valley, is one of the world's greatest mosquito fighters—J. A. Le Prince of the U.S. Public Health Service. Veteran of mosquito campaigns extending back to the early days, when yellow fever and malaria were wiped out at Panama before the canal was built, Major Le Prince is now busy with important research work.

Despite the many splendid efforts being made to control malaria, the job remains exceedingly difficult and requires eternal vigilance. This is illustrated in Kentucky, where surveys have revealed that the disease is much more prevalent throughout the state than is generally believed and—what is more important—it is spreading into areas heretofore unaffected.

Control measures underway

Several drainage projects, in which the U. S. Public Health Service has taken active part, are under way in the vicinity of Cairo and at Paducah; the mosquitoes are also fought with larvicide applications in swampy areas and the stocking of impounded waters with mosquito-destroying minnows (*Gambusia affinis*). Trapping records and flight studies have been highly useful in determining where control measures are needed. Thus far 34 varieties of mosquitoes have been identified in the state of Kentucky among which are several malaria-transmitting species, principally *Anopheles quadrimaculatus* and *A. punctipennis*.

Men for the job ahead

The South's intense activity in sanitation leads to the question, Are men enough available to carry on this work? The answer is that up to the present enough men have been available, but now there is developing a shortage of specially trained personnel. To aid in meeting these needs a new graduate school for training sanitary engineers and public health officers has been established at the University of North Carolina. This school has been designated by the U. S. Public Health Service as a training center for men in seven of the southeastern states. Similar centers have been established at Vanderbilt University in Nashville, Tenn. and in four other colleges serving other sections of the country.

While the South is making splendid progress in its sanitation program, the greater bulk of work is yet to come. Present activity is mainly directed toward catching up on deferred improvements, but the movement cannot resist the influence of new and greater demands stimulated by rapid growth. Southern industrial expansion is going ahead on a broad front, and this will assure consistent impetus to further development.

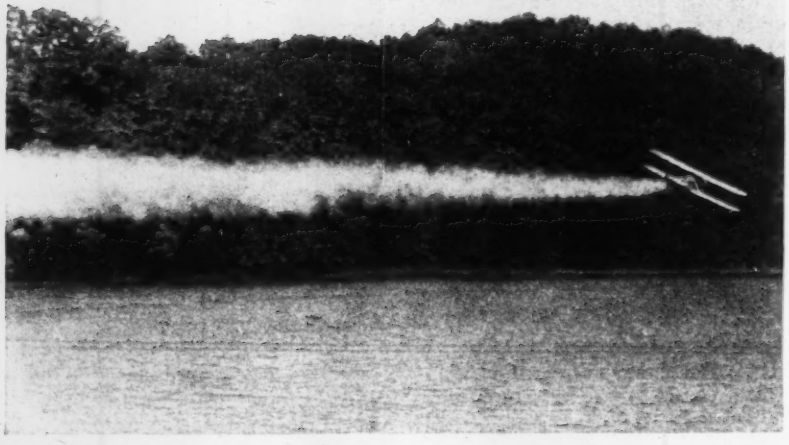

Fig. 5. Mosquito breeding in impounded waters can be effectively controlled by airplane spraying with paris green.

FIG. I. WELLPOINTS DRYING UP A PIER SITE FOR A NEW BRIDGE ACROSS THE REPUBLICAN RIVER.

Wellpoints on Small Bridge Work

by LA MOTTE GROVER

Office Bridge Engineer, Kansas State Highway Commission, Topeka

The use of wellpoints in place of more conventional foundation methods on several Kansas jobs results in satisfaction, speed and economy

ALTHOUGH wellpoints as aids to foundation excavation and construction are usually thought of as being applicable only to special and difficult problems, on several jobs in Kansas their adoption for quite ordinary foundation work has proved to be justified. Three bridges across the Republican River in the northern part of the state, a bridge at Goodland and a railroad grade separation job at Lawrence may be cited.

The Republican River jobs are at St. Francis, Scandia and Clay Center. On the first two, the foundations are pairs of circular piers (supporting concrete bents) carried to shale 13 ft. below streambed At Clay Center an extension to a comparatively new existing bridge involved the removal of a pedestal-type abutment with pile footings 8 ft. below streambed and its replacement by a pier founded on rock 24 ft. below streambed.

The Republican River is a typical sandy valley stream with quite definite flood periods, two characteristics

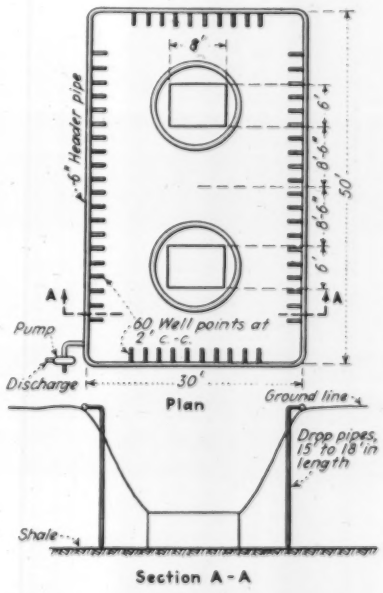

Fig. 2. Wellpoints as installed around a pier site of the St. Francis bridge on the Republican.

required for the successful and economical application of wellpoints to bridge foundation work. The wellpoint system used for the bridges consisted of a ring of 6-in. header pipe around the excavations, with 1¼- or 1½-in. pipe connections on 2 to 3 ft. centers, leading to the wellpoints which were 2½-in. outside diameter. The close spacing was adopted after a 4-ft. spacing of the points had been tried and found inadequate.

Usually two 6-in. centrifugal pumps, with auxiliary vacuum pumps, were used, one on each of two opposite sides or corners of the ring, to provide for continuous operation in case of breakdown of one pump. The standby unit is important because if pumping is stopped and the water rises the sand caves badly, and a number of hours are required to lower the water again. On one of the piers at Clay Center the water rose almost to normal elevation when the pumps were out of service 30 hr.; it required 4 hr. after the pumps had been started again to gain

any headway in lowering the water level. In another case the water had not been lowered to its lowest elevation until the pumps had been operating for more than 48 hours.

Since a single row or stage of wellpoints will overcome a head of about 15 ft. of water, such installations were adequate at St. Francis and at Scandia to handle all the water except a small amount that entered the excavation along the top of the shale stratum. As a practicable procedure for maintaining a clean shale foundation for the concrete, the wellpoints were supplemented by shallow steel ring cofferdams sunk in the bottom of the excavation in one case (Fig. 3) and by driving short lengths of sheet piling to form an enclosure in the other case. A 2-in. pump was more than adequate to keep these cofferdams dry.

Ordinary small jobs

The ring of 6-in. header pipe for the work at St. Francis (Fig. 2) was 50 ft. by 30 ft., and 60 wellpoints were joined to the header through drop pipes 15 to 18 ft. long, the connection being made by swinging pipe joints. Although two pumps were used during the construction of the first two piers, only one pump was used thereafter; this pump operated continuously for three weeks (except during oil changes) on one pier that was constructed during unfavorable river conditions. The points were jetted down with a 3-in. two-stage pump operating in series with one of the 6-in pumps.

A wellpoint system was adopted for this job in the first place because of the probability of encountering concrete debris from the old bridge that had been washed out in the 1935 flood. However, the cost of making the excavation with the aid of wellpoints was found to compare very favorably with conventional methods, despite the fact that a certain amount of experimentation was necessary before the construction forces familiarized themselves with their operation.

At Clay Center, the wellpoints were used in an auxiliary capacity to permit an existing abutment, with comparatively shallow footings, to be removed before a cofferdam was driven for a new and deeper foundation. The use of wellpoints permitted the use of short timber sheeting and a small cofferdam for the lower part of the excavation to rock. Without them, long steel sheeting would have been necessary, and it would have had to be extended around the toes of the old abutment, entailing very difficult driving under or through the superstructure of the end span of the existing bridge. A ring of header pipe, about 50 ft. by 40 ft. and 60 wellpoints at 3 ft. centers were used at this location, which was adjacent to the widened channel cut by the 1935 flood. (*ENR*, Oct. 17, 1935, p. 533.)

At the next pier, 90 ft. back toward the north bank, a system of 74 points was installed and, through the influence of these points, the groundwater at the pier 50 ft. to the north, where no points were installed, was lowered from a 12-ft. depth over footing elevation to only 3 ft. At one of the other piers a single straight row of 14 points, installed between the two footings, lowered the water from a 12-ft. depth over footing elevation to 4 ft., permitting the use of shallow inexpensive cofferdams that did not have to be carried around the web between the pier columns.

In constructing thirteen piers and the abutments of a 525-ft. concrete deck-girder bridge on the North Fork of the Smoky Hill River south of Goodland, 59 wellpoints in a single straight row were tapped into a header pipe 200 ft. long on the centerline of the project, extending past five piers near the middle of the bridge. It took six men only 3½ hr. to jet these points

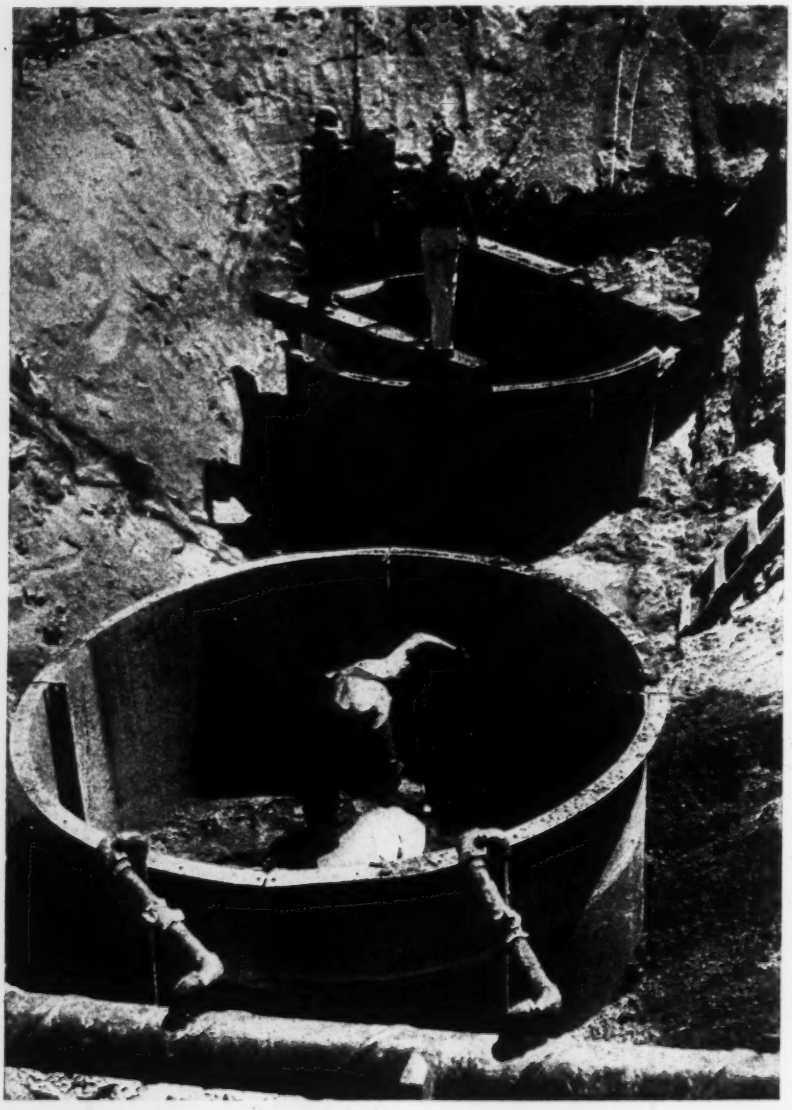

Fig. 3. Protected by a ring of wellpoints, excavation in these circular steel plate cofferdams for two of the St. Francis bridge piers was carried out in the dry. The cofferdam in the background is being driven into the underground shale with a drop hammer.

into the ground 23 ft. below the surface. Groundwater elevation, ranging from 2 to 4 ft. below the surface at various piers, was lowered from 6 to 8 ft. in some cases, permitting the footings to be placed in the dry without the use of a cofferdam.

Although the system ended some 130 ft. short of one abutment and 145 ft. short of the other, and the low-water channel of the river crosses between the end of the system and the first abutment, groundwater elevation at the abutment was lowered to within 2½ to 3 ft. of that at the piers where the points were installed. Only very simple and inexpensive cofferdams were required near the ends of the bridge. This rather phenomenal condition is explained by the fact that, although the soil across the valley is quite sandy, the bed of the low-water channel had become silted up and rendered sufficiently impervious so that it acted as a flume to carry the streamflow. In fact, pier No. 2 was put down in the river bed, 100 ft. from the south end of the wellpoint system, with the lowered groundwater level no higher than at the piers on either side of it. (Fig. 4).

On this job it was particularly important to maintain continuity of operation, for it took ten days to lower the groundwater 8 ft., and when the pump was shut down for only an hour on one occasion the water rose about 3 ft., requiring three days of pumping to lower it again.

Under somewhat different conditions than prevailed on the several river jobs, a wellpoint system has been used in connection with the construction of a 900-ft. subway structure to carry highway routes U.S. 40 and U.S. 59 under the Union Pacific R.R. at Lawrence, Kan. A comparatively small system was first installed to aid the construction of a permanent pump house and wellpit structure near the center of the subway. Then a ring 310 ft. by 70 ft., with 96 self-jetting wellpoints, was installed to lower the groundwater some 3 ft. during the construction of the base slabs of the railway structure and the part of the retaining wall approaches on the south side that involved a base slab below groundwater elevation (Fig. 5). As soon as the railway structure was completed, the tracks were transferred to it from the temporary shoofly bridge shown in the illustration, and the wellpoint system was moved to the north side to aid in completing the retaining wall approaches there.

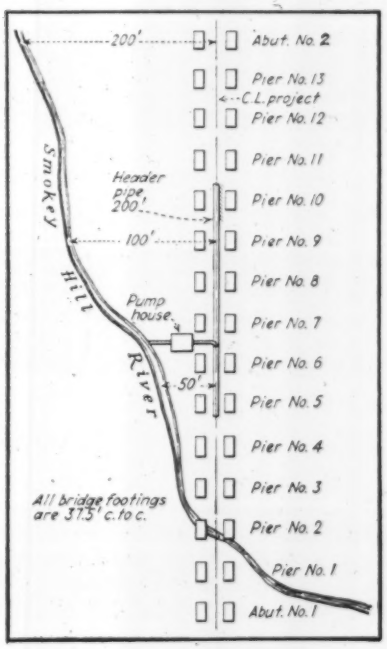

Fig. 4. Single row of points placed on the centerline of a bridge near Goodland, Kan.

The systems have, therefore, proved to be quite versatile in making the most of the equipment available. They have been found to be particularly advantageous in fine sand that ordinarily would leak through the joints of steel or timber sheeting.

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All of these structures are projects of the state highway commission of Kansas. The bridge at St. Francis was constructed by the Omaha Steel Works as general contractor and fabricator, with H. N. Conrad, contracting engineer, and Fred Carlson in general charge of the work. C. W. Lind, superintendent, and Lloyd Williams, bridge engineer. Morrell Dexter was state resident engineer.

The work at Clay Center was performed by the D. G. Hansen Construction Co., with Donald Wilse in charge for the contractor, and with L. F. Kepley resident engineer and H. L. Kipfer bridge inspector for the state.

R. G. Porter is resident engineer and G. S. Davis bridge inspector for the state highway commission at Lawrence, while C. W. Cubbage is superintendent for the Kansas City Bridge Co.

The wellpoint system used at St. Francis was furnished by the Jaeger Machine Co., Columbus, Ohio, the systems at Clay Center and Scandia by the Sterling Machinery Corp., Kansas City, Mo., and the system at Lawrence by the Moretrench Corp., Rockaway, N. J. Each of these companies cooperated extensively in planning the construction procedures and in administering them in the field.

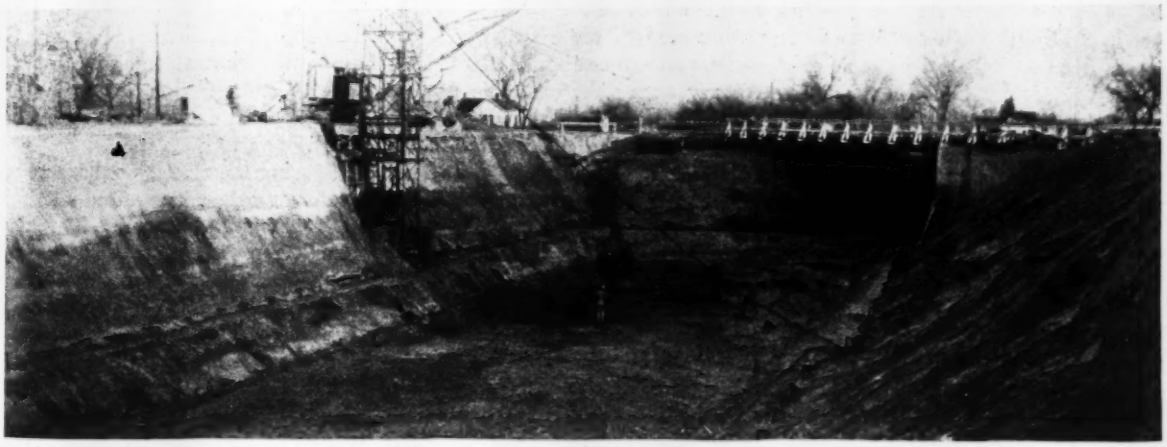

Fig. 5. Dry approach in sand to a railroad grade separation at Lawrence made possible by a 310x70 ft. ring of wellpoints. Operated continuously for 7 weeks, the system permitted the pouring of much of the concrete in the dry.

FIG. 1. TURNING THE CUYAHOGA RIVER INTO A NEW CHANNEL OUTSIDE THE PLANT SITE

Foundation Job Includes Moving a River

Eighty-acre site of the New Republic Steel Corp. rolling mill at Cleveland raised 5 ft. above old level with 75,000 cu.yd. of fill

WHEN the Republic Steel Corp. decided last fall to build a steel sheet mill at Cleveland to provide a complementary finishing capacity for its existing Corrigan-McKinney furnaces, it put up to the contractors a construction problem of unusual magnitude in the industrial building field for it chose a low-lying site, cut in two by the Cuyahoga River, and asked that a $15,000,000 steel plant be operating on it by September, 1937, eight months from the time the contractors moved in. Furthermore, it topped off these demands by choosing, unwittingly, a year in which an open winter and a January flood descended on the foundation contractor in full force.

As a sequel to these events it is now expected that in September, 1937, the widest sheet mill in America will go into production as planned. A good share of the credit for this accomplishment goes to the contractors who moved the river to the edge of the site, placed 750,000 cu. yd. of fill over an 80-acre area and built the foundations without delaying steel erection or rolling mill equipment installation.

The site which it was necessary to prepare for the steel mill was, as stated, in the bottom lands of the Cuyahoga River valley. Actually about one-third of it was on the wrong side of the river, which described an oxbow about 2,000 ft. long directly across the site. The general elevation of the land was about +10, (city datum) with low water in the river at El. —3. Although the land had been used as a farm it was inclined toward swampiness. The soil is largely silt overlying alternate lenses of quicksand down to 60 ft. below natural ground level where a shale stratum at least 30 ft. thick occurs. Under the circumstances, all foundations were required to be on piles, and the piles under the heavy machinery had to be driven to the shale.

The mode of attack was first to effect a cut-off along the edge of the site to eliminate the oxbow bend. Then it was required to fill the old river channel and to raise the ground level to El. +14.5 so that top of rail in the yards could be at El. +15.5; mill building floors will be at El. +20. Although buildings occupy only 21 acres, the entire 80-acre site had to be filled to accommodate extensive railroad yards, since steel is brought from the furnaces 2 miles downstream by rail, and all shipments are by rail, the site being a mile above navigation in the river.

Moving the river was the first and major task since it required digging a new channel 1,300 ft. long, 23 ft. deep and 200 ft. wide at the top of 1:1 side slopes. The plan of operation was to leave plugs about 40 ft. thick at either end and between them to excavate the channel to its full depth and width. Three 12-yd. self-loading scoops hauled by tractors made the first 15-ft. of the cut. Work began at the upper end of the channel. The tractors and scoops operating in tandem were

Cleveland Tractor Photo.

Fig. 2. Tractor-hauled scoops of 12-yd. capacity which worked 24 hours a day for 20 days in removing 125,000 cu.yd. of material from this new river channel.

moved in circles from the digging to the dumping point, the length of haul being kept down to about 1,500 ft. Working three 8-hr. shifts, this equipment moved 125,000 cu.yd. out of the channel cut in 20 days, and deposited it on the plant site.

When excavation reached El—5, the ground became too saturated for scoop excavation, and draglines were substituted. Two 1½-yd. machines, set up on the side opposite the plant site, pulled the material from the cut into piles along the bank, where it was allowed to dry. Eventually it will be graded down to yard level.

All of this excavation work was carried on under the worst possible weather conditions of raining, freezing and thawing. Finally, in the middle of January, heavy floods moved down the river and threatened the partly-completed fill. Dikes were hurriedly thrown up along the plant side of the new cut in an attempt to keep the water out of the old river course. The plan was successful to the extent that scour was checked, but the water overflowed the whole site and shut down operations for several days.

After the water receded the site was a sea of mud and, since no time or weather was available to permit drying it out, recourse was had to mixing the material to be used for the fill with slag. By alternately dumping slag and earth, and mixing them with bulldozers, it was possible to build up a fill that gave reasonably good compaction. Many trainloads of slag were required.

After the channel was completed, the draglines removed the upper and lower plugs, permitting the water to flow through the cutoff. This was followed by damming the ends of the old channel with fill pushed out from the bank by bulldozers. An oxbow lake resulted which was filled in as the water was pumped out.

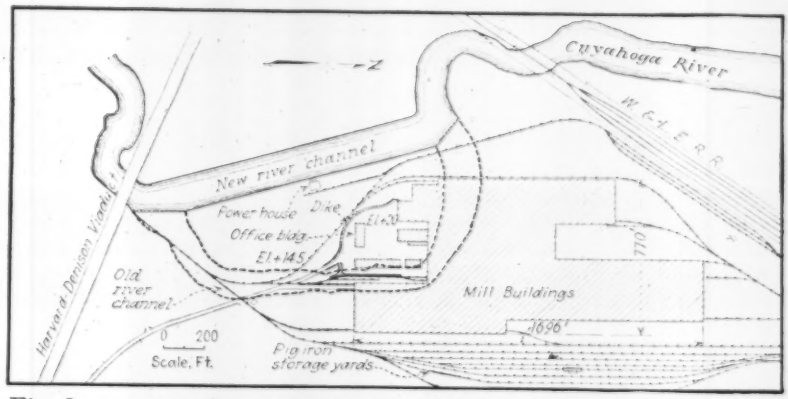

Fig. 3. Plot plan of new sheet mill of Republic Steel Corp. at Cleveland showing oxbow bend in river which was eliminated by a cutoff.

Fig. 4. Tough going in the mud of the steel mill site. Only by mixing slag with the earth fill was it possible to secure compaction.

The excavation from the cutoff channel provided only a small part of the fill material required. The remainder came from a high hill on the east side of the site where two shovels were set up in a borrowpit. A total of 25 trucks and 4 tractor-hauled

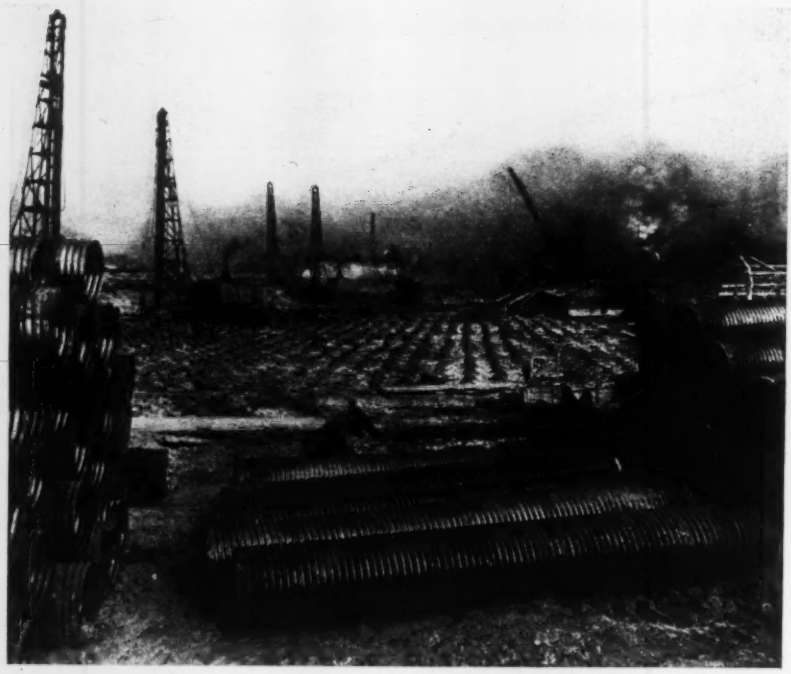

Fig. 5. Eight pile drivers drove 17,000 concrete piles into the ground to support the buildings and rolling mill machinery.

12-cu.yd. crawler wagons were used to transport the material, which was spread with bulldozers.

Concurrent with excavation and fill operations, foundation construction was carried on. Eight skid-mounted pile drivers were used, and by the time fill operations were complete 17,000 concrete piles were in place in the 21 acres to be occupied by buildings. Some 5,000 of these were friction piles of tapered type averaging 38 ft. long; the remainder, of stepped type, were driven to the shale and designed for a load of 35 tons each. The shells, driven with mandrels, were filled with concrete mixed in pavers that were moved about the site. Materials batched at a plant near the edge of the site were trucked to the pavers over slag and corduroy roads.

After the piles were driven, a 6-in. unreinforced concrete slab was poured over them and directly on the mud to serve as a working platform. This novel expedient kept subsequent operations out of the mud, and provided a base upon which the structural slab reinforcing could be assembled.

As a final operation on the foundation phase of this steel mill building job, a sheet pile wall was driven along the plant side of the new cut-off channel. About 1,300 ft. long, this wall will hold the fill and eliminate scour. It makes the job of moving the river complete.

* * *

The Cleveland sheet mill of the Republic Steel Corp. is being built under the direction of J. H. Van Campen, chief engineer of the Corrigan-McKinney Works. J. K. Harris is field superintendent for the Republic Steel Corp. The Hunkin-Conkey Construction Co., Cleveland, is general contractor, with Louie Tagliaferro as superintendent. The A. B. Cable Co. held the subcontract for excavating and filling and the Raymond Concrete Pile Co. for pile driving.

Leading facts about the Republic's Cleveland sheet mill are:

1. The mill has a 98-in. nominal width as compared with the 96-in. Carnegie-Illinois mill at Homestead, Pa. and thus is the largest in the world. Rolls sheets 92 in. wide. Capable of passing a 20-gage sheet at a speed of 23.7 m.p.h. (2100 ft. per min.)
2. Buildings cover 21 acres; nearly 60 acres of railroad yards and 5 miles of track surround the buildings.
3. Buildings require 15,000 tons of steel.
4. Maximum building length, 1696 ft. Total width 770 ft., made up of seven 105-ft. spans, and two aisle spans.
5. New type roofs consisting of welded bar joist purlins and a pressed steel insulated flat deck.

Fig. 6. Only a lake remains of the old channel of the Cuyahoga River. Two weeks after this picture was taken the lake was filled in and the sheetpile wall along the new channel at the left was completed.

Deepening the St. Lawrence River

Board of government engineers reports on one of the major engineering questions at the present time in Canada

A REPORT on the causes of low water levels in Montreal harbor and in the ship channel of the St. Lawrence River and an analysis of methods for correcting the present unfavorable conditions was submitted to C. D. Howe, Minister of Transport of the Dominion of Canada in January of this year by an inter-departmental board of engineers. This report with its recommendations recently was made public by Mr. Howe. It is a document of wide interest to the engineering profession.

Unusually low-water conditions in the Montreal Harbor and in the navigation channel down the river to Quebec have been a source of considerable concern in recent years and frequently have made it necessary for ocean liners to transfer part of their cargo by rail to Quebec in order to reduce their draft in the upper reaches of the river. These conditions resulted in the appointment in January, 1934, of a board consisting of N. B. MacLean, chief engineer, and Alphonse Lafleche, assistant chief engineer, St. Lawrence Ship Channel, F. Anderson, director, Hydrographic Service of Canada, K. M. Cameron, chief engineer, and J. L. Dansereau, district engineer, Department of Public Works, Montreal, D. W. McLachlan, engineer in charge of the St. Lawrence Waterway and Hudson Bay Terminal of the old Department of Railways and Canals, and J. T. Johnston, director, Dominion Water Power and Hydrometric Bureau. Since the report of the board was submitted Mr. Lafleche has died.

Many proposals for correcting flow conditions in the river were considered by the board, including continuation of the extensive dredging program that has been in progress for some years past, the construction of submerged weirs to concentrate the flow in the main channels, and the construction of dams and locks. The board was unanimous in its findings as to the causes of low water levels but not as to possible remedies, five members presenting a majority finding which recommended further dredging, and two members presenting minority reports recommending in one case a gradual program of development, and the other case delay in carrying out of all major work until economic conditions justify the expenditures involved.

In 1826, when the necessity for dredging the river was first publicly recognized, the least draft across Lake St. Peter was 10½ ft. Dredging started in 1844 and has continued ever since. By the fall of 1882, a channel 25 ft. deep and 300 ft. wide had been practically completed; by 1899 the available depth had been increased to 27½ ft., but dredging continued from that year in order to give a 30-ft. channel below a new datum plane, called the 1897 datum, which had been established following extreme low water in 1895. This 30-ft. project was completed in 1910, with a width of 450 ft. on tangents, and 800 ft. on curves.

In the same year a project was begun to give a minimum depth of 35 ft. below the 1897 datum plane. This work is now almost completed, although the low water conditions of 1934 did not result in the full depth being available in those sections of the channel that had been dredged to the specified depth.

The total expenditure on the dredging now amounts to $61,000,000, the last stage (developing the 35-ft. project) having cost $49,000,000 in its present uncompleted condition.

Because questions had been raised as to whether the continued decline of water levels at Montreal was not due in part at least to the dredging work to deepen the channel below Montreal, special attention was given to the effect of dredging by the board of engineers.

Water levels at Montreal

On the subject of water level changes at Montreal the board states that they are due to a number of interacting causes of which two are most important: the volume of discharge of the river, and the change in shape and size of the channel below Montreal.

Though water level records of varying degrees of completeness are available for Montreal harbor as far back

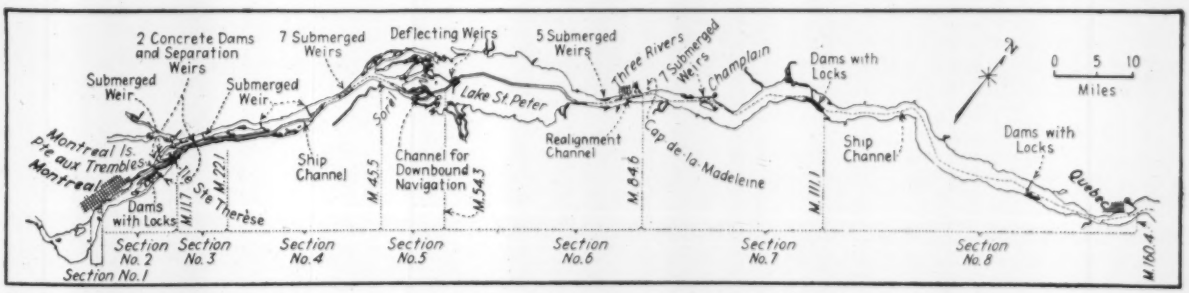

Fig. 1. Proposals for improving the ship channel in the St. Lawrence River between Montreal and Quebec. The board adopted none of the major proposals but favored minor ones combined with continued dredging.

as 1869, the board began its study with the year 1880 and made direct comparisons between the levels of 1895 and 1897 and those of recent years. The extreme case considered by the board was a change in level of 2.98 ft. between October and November mean low-water levels in 1934 and 1897. The board was in agreement that of this amount, 0.34 ft. is due to the Chicago division, 1.13 ft. to decreased run-off, 2.05 ft. to dredging; with an increase in level of 0.54 ft. due to the construction of submerged weirs at Sorel, to wind and other local influences.

Increased flow at Montreal

On the subject of increasing the low-water discharge at Montreal the board points out that the average diversion at Chicago for the last fifteen years of 8,540 sec.-ft. is to be reduced to 3,200 sec.-ft. after the year 1938 under the orders of the U. S. Supreme Court. This reduction, according to the board, will result in an increase in water levels at Montreal of 2.75 in.

A proposed diversion of the flow of the Ogaki River from the Hudson Bay watershed into Lake Superior, a proposal that has been considered by the Ontario Hydro-Electric Power Commission, would result in an increase in water levels at Montreal of 2.5 in.

Possible regulation of the flow from Lake Superior was considered but was found to be of no value as affecting water levels at Montreal. Regulation of flow from Lake Ontario, as proposed under the plan for developing the international section of the river between Lake Ontario and Montreal, would result in an increase of 6 in. at Montreal. The total possible increase from these sources would be over 11 in., but most of the increase could only be obtained by international agreement.

Regulating works

Studies of the 160-mile ship channel from Montreal harbor to Quebec indicated that there were three general ways in which the channel might be improved: regulating dams with locks, regulating weirs and training works, and dredging.

Three proposals for the construction of regulating dams with locks at points 11, 110 and 145 miles below Montreal, were estimated to cost $37,000,000, $53,000,000 and $58,000,000 respectively, excluding possible damages due to raising of river levels. All dams were to be equipped with twin locks, 900 ft. long and 90 ft. wide. The rise in water level at Montreal would be 1.3 ft. if either of the two lower projects were built, and would be somewhat more if the third were built. All were discarded by the board, as being definitely uneconomic when compared with dredging and as presenting unknowns as to the extent of land damage along the river banks and the effect on ice breaking operations in the early spring.

Eight separate proposals for the construction of weirs at locations between Champlain, 94 miles below Montreal and Pointe au Trembles at the foot of the Island of Montreal were considered. Costs ranged from $600,000 to $7,500,000 and the possible effect at Montreal varied widely. The board was unable to recommend serious consideration of any of the proposals.

In the period between 1928 and 1931 submerged rock weirs were built in some of the channels into which the river divides at the head of Lake St. Peter in the vicinity of Sorel. Recently these weirs were raised with considerable damage to adjacent land and with resulting increase in channel velocity that are declared to be detrimental to navigation. The board was unanimous in recommending that one of the existing weirs should be removed, that all others should be lowered to 2 ft. above low-water level; also that one small weir should be built across a side channel. The net result will be a reduction of by 20 per cent of the improvement at present given at Montreal by these weirs (about 5 in.) The estimated cost of the proposed work is $835,000.

The board also considered a proposed scheme for training works centering on Ile Ste. Therese, a large island in the main channel at the foot of the Island of Montreal, which would have the effect of raising the water level in Montreal Harbor by 1.65 ft., with only minor local inconvenience. The cost of the dams and control works is estimated at $10,508,000.

Dredging requirements

Dredging was considered in the light of the work done up to the present, one of the board's first dredging studies being an investigation of the cost of completing the 35-ft. project to the old 1897 datum. It is estimated that this can be done in 1937 at a cost of $1,600,000.

Next considered was the cost of dredging a 35-ft. channel below the newly adopted low-level datum of the Hydrographic Service, based on the low water levels of 1934, or 2 ft. below the old datum. This cost was found to be $13,521,000 if completed to Quebec, but only $6,559,000 if carried out as far as Cap de la Madeleine, below which point tidal influence is felt and ships of deep draft can wait for high tide at times of low water. The channel will enable ships drawing 31.5 ft. to go in and out of Montreal Harbor, except under the most extreme conditions of low water.

The board unanimously recommended that a realignment of the main ship channel should be dredged opposite the port of Three Rivers where the channel lies close to the main wharves.

Recommendations

The majority of five members of the board recommend the dredging work at Three Rivers and the weir reconstruction at Sorel, also the dredging to a 35-ft. depth below the 1934 datum from Montreal to Quebec at a total cost of $14,856,000. They further recommend that if greater depths are required, or if water levels recede still farther, then serious consideration should be given to the possibility of carrying out the Ile. Ste. Therese training works. The minority proposed some modifications of this program. Mr. McLachlen, now engineer of design and capital construction in the recently created Department of Transport, in a separate report, devotes considerable attention to economic questions. He holds that the best form of improvement of the ship channel is remedial work, coupled with limited dredging but that the execution of the project should be delayed about ten years or until the volume of overseas traffic in and out of Montreal has increased about 50 per cent. He states that no form of channel deepening by dredging alone has been found which approaches economic justification on national grounds, even with a large increase in traffic. He notes further that the low-water levels at Three Rivers has only fallen 3.5 in. since 1895. Consequently he can see no economic justification for deeper dredging below that point.

THE WEEK'S EVENTS

Continued from page 857

New York Suit Will Test Water Power Grants

New York State has filed suit in the N. Y. Supreme Court in an attempt to compel the Niagara Falls Power Company to pay rental for all water which it diverts from the Niagara River. The suit was filed in behalf of the State Water Power and Control Commission. In February the commission served notice on the power company to desist from its diversion of 15,100 sec.-ft. of water from the Niagara River. The company refused to comply with the order, basing its refusal on legislative acts of 1892, 1893 and 1896, which gave its predecessor the right to divert 15,100 sec.-ft. without payment.

The power company has been diverting a total of about 20,000 sec.-ft., but pays rental to the state for 4,900 sec.-ft. The right of the commission to fix rental rates on a portion of this was upheld in the state courts early last year after lengthy litigation from which the U. S. Supreme Court refused to entertain an appeal.

The chief point at issue in the present test suit concerns the constitutionality of the legislative acts under which the power company was given the right to divert water without charge.

The power company, in refusing to comply with the commission's order and inviting court action, cited the legislative acts mentioned and the continued legislative sanction since that time.

The commission has declared that the waters of the Niagara River, "belonging to all the people of the state, have been diverted for private use and profit by a corporation operating under acts of the legislature whose constitutionality is in doubt. The Water Power and Control Commission believes that the courts should now say whether or not the state should receive a fair rental for all water diverted from the Niagara River for private profit, not merely a portion of such diversion, as at present."

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Engineers Receive Awards From Franklin Institute

Among those receiving the 1937 medal awards for scientific ingenuity and skill, May 19, of the Franklin Institute of the State of Pennsylvania were two civil engineers, Inge Lyse, and William Bowie.

The Louis Edward Levy medal, founded in 1923 and awarded "to the author of a paper of special merit published in the Journal of the Franklin Institute" was awarded to Inge Lyse, professor of engineering materials, Lehigh University, Bethlehem Pa., for his series of papers on "A Study of the Quality, the Design and the Economy of Concrete," published in the April, May, June and July issues of the Journal.

Dr. William Bowie, who recently retired from the U. S. Coast and Geodetic Survey, received the Elliott Cresson medal which was founded in 1848 and is awarded for discovery or original research, irrespective of commercial value. The award was made in consideration of Dr. Bowie's constribution to the science of geodesy, particularly with reference to the theory of isostasy.

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PERSONAL

A. G. DARWIN has been appointed engineer of Garfield County, Wash.

B. H. FRASCH has been appointed chief engineer of maintenance in the Ohio state highway department.

ARTHUR C. EBERHARD has been enrolled as a lieutenant commander in the Civil Engineers Corps of the Navy.

JULES ARCHAMBAULT, formerly with Bell Telephone Co. of Canada, has been appointed chief engineer of the Montreal Tramways Commission.

CHRIS STITCHNATH, 71, has retired after 18 years of service as assistant city engineer of Cincinnati and 35 years service for the city.

LT. COMMDR. CHARLES T. DICKEMAN, Corps of Engineers, U. S. Navy, has left the naval operating base at San Diego, Calif., to serve as public works officer at the Marine Barracks, Quantico, Va.,

GLEN E. CRIPPER is now with the dams division of the Bureau of Reclamation in Denver. He was formerly superintendent of construction for the Soil Conservation Corps at Red Oak, Ia.

J. G. CHENEVERT and E. NENNIGER, engineers, who have been associated for some years with the firm of Arthur Surveyer & Co., of Montreal, have been taken into partnership in that firm.

JOSEPH T. BANNER has been appointed assistant water consultant for the National Resources Committee with headquarters in Salt Lake City. For the past seven years Mr. Banner has been assistant field engineer for the Denver municipal water board.

E. R. ROMBERG, an engineer on flood control work with the Boston district of the U. S. Engineers, has taken a position as general manager of the Coachella County water district at Coachella, Calif.

LT. COL. EUGENE REYBOLD, district engineer for the U. S. Engineers at Memphis, Tenn., has been appointed division engineer of the newly created Arkansas Division, with headquarters at Little Rock. The appointment is to become effective July 1.

N. W. HICKS, P. G. POORE, and O. E. CUTTING, acting state highway engineer, acting assistant highway engineer, and acting secretary to the highway commission, respectively, of Montana since Jan. 16 have been given permanent appointments.

D. L. ERICKSON, city engineer, Lincoln, Neb., has been appointed director of parks, public property and improvements under a new form of government which is a compromise between the mayor-council form and city manager form, whereby the councilman's duties are legislative only and three directors handle all administrative functions. Mr. Erickson has charge of the city engineers office, water and light department, paving repair and sewer maintenance, street department, paving repair and sewer maintenance departments, park department and municipal airport.

OSCAR E. SELBY, principal assistant engineer of the Big Four R.R., retired recently, ending an association of almost 48 years with that line. A graduate of Iowa University, Mr. Selby entered the employ of the Big Four in 1889 as assistant engineer and later resident engineer on the construction of the Louisville and Jefferson Bridge. Shortly thereafter he became assistant engineer in the chief engineer's office at Cincinnati and was later engineer of bridges and structures. He assumed the position from which he is now retiring in 1915. He is succeeded as principal assistant engineer by A. F. MAISCHAIDER.

W. M. POST, assistant chief signal engineer of the Pennsylvania R.R. system, has been appointed signal engineer with offices in Philadelphia, as at present. H. L. STANTON, superintendent of telegraph and signals in the eastern region has been promoted to assistant chief engineer of signals on the staff of the chief engineer at Philadelphia. He will be succeeded in the eastern region by C. W. HIXSON, now superintendent of telegraph and signals in the western region at Chicago. R. F. RAUGHLEY, now assistant superintendent of telegraph and

signals in the eastern region becomes superintendent of telegraph and signals in the western region.

K. C. WRIGHT, chief engineer of the Utah State Road Commission resigned recently to take a position as manager of the industrial equipment division of the Lang Co., at Salt Lake City. Mr. Wright is succeeded as chief engineer by E. C. KNOWLTON, formerly assistant chief engineer. M. C. MOFFAT, locating engineer for the commission, becomes assistant engineer in charge of plans and estimates. Mr. Wright has been connected with the road commission since his graduation in 1915 from the engineering school of the University of Utah. He started with the commission as a designer in the bridge department, becoming district engineer in 1925, and assistant engineer in charge of construction in 1927. He was appointed chief engineer in 1934.

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Asphalt Institute Will Meet At Memphis in December

The board of directors of the Asphalt Institute have decided to hold the 1937 National Asphalt Conference in Memphis during the week of Dec. 6. The conference will cover the subjects of road building, soil stabilization, flood control, harbor protection, and airport surfacing. It will be, according to the Institute, a clinic on all highway problems.

The Association of Asphalt Paving Technologists will meet at the same time as the National Asphalt Conference, probably in a three-day session.

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Ground for New Steel Plant Broken at Pittsburgh

Ground-breaking ceremonies were held May 22 as construction began on the new Irvin Works of the Carnegie-Illinois Steel Corp. near Pittsburgh. The $63,000,000 Irvin Works will comprise a building layout almost a mile long and about a quarter of a mile wide. It will include 52 acres of mills and more than 100 acres of warehouse, shipping and other facilities. Contracts for general excavation, for foundations, and for sewers have already been let and bids on tools and equipment for the mills are now being studied.

Among the u..its at the plant will be an eighty-inch hot strip mill housed with its accessory structures in a building, 2,520 ft. long. Other mills will be an 84-in. three-stand, tandem, cold-reduction mill, a 54-in. four-high reversing-type cold-reduction mill.

The new works are named after William A. Irvin, president of the U. S. Steel Corp.

CALENDAR OF MEETINGS

ENGINEERING INSTITUTE OF CANADA, semi-centenial celebration, Montreal and Ottawa, Canada, week of June 15.

AMERICAN SOCIETY OF AGRICULTURAL ENGINEERS, annual meeting, Urbana, Ill., June 21-24.

AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS, summer convention, Milwaukee, Wisc., June 21-25.

SOCIETY FOR THE PROMOTION OF ENGINEERING EDUCATION, annual meeting, Cambridge, Mass., June 28-July 2.

AMERICAN SOCIETY FOR TESTING MATERIALS, annual meeting, New York City, June 28-July 2.

AMERICAN SOCIETY OF CIVIL ENGINEERS, annual convention, Detroit, Mich., July 21-24.

PENNSYLVANIA SEWAGE WORKS ASSOCIATION, annual conference, State College, Pa., June 21-23.

NEW OFFICERS ELECTED

MICHIGAN ENGINEERING SOCIETY at its recent Saginaw meeting elected the following officers: President, George W. Francis; vice president, H. B. Dirks; secretary, Earl R. Weeber; executive secretary, E. L. Brandt.

The SOUTHERN OHIO SOCIETY OF PROFESSIONAL ENGINEERS at a recent meeting elected the following officers; A. P. Cooper, president, and Clyde E. Haeger, vice-president.

THE INDIANA ENGINEERING COUNCIL at a Feb. 17 meeting in Indianapolis elected M. R. Keefe to the presidency. Other officers named were F. R. Weaver, vice-president; Homer Rupard, secretary-treasurer.

J. R. Burkey, chief engineer of bridges of the Ohio Department of Highways, was elected president of the OHIO SOCIETY OF PROFESSIONAL ENGINEERS at a recent meeting. Other officers elected were Harry C. Miller of Sidney and Victor E. Smith of Dayton, vice-presidents, and E. G. Cantwell of Columbus, treasurer.

Recent elections to the INDIANA ENGINEERING COUNCIL include B. R. Keefe, president; F. R. Weaver, vice-president; and Homer Rupard, secretary-treasurer. The council is composed of the Indiana chapter of A.I.E.E., A.S.C.E. and A.S.M.E.

The ENGINEERING SOCIETY of WISCONSIN at its Madison meeting March 4 and 5 elected Robert C. Johnson, president, and C. A. Wiepking, vice-president. A bill for state registration of waterworks and sewage plant operators was approved. Registration of professional engineers has progressed to a point where coordination of the engineering societies of the state is essential and a committee was appointed to further this plan.

At the May 10 meeting at Fort Belvoir, Va. of the SOCIETY OF AMERICAN MILITARY ENGINEERS, the following officers were elected; president, Rear Admiral H. E. Bakenhus; first vice-president, Brig. Gen. Charles Keller; second vice-president, Col. W. T. Chevalier. Col. Harrison Brand, Jr. was re-elected treasurer, and Col. W. P. Wooten was re-elected executive secretary. Papers by Lt. Col. C. P. Gross, Capt. Walter E. Lorence and Constantine Brown dealt with the mechanization of warfare, the Italian campaign in Ethiopia, and the present political conditions in Europe.

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License Examinations

IOWA: Examinations for professional engineers June 8 and 9, and examinations for surveyors June 10 in the Senate Chamber at the State House, Des Moines, Iowa.

MICHIGAN: Examinations for architects at the University of Detroit and examinations for engineers and surveyors at the University of Detroit, the Michigan State College, the Michigan College of Mines, and at Ironwood, June 21-23. Information may be obtained from the Michigan State Board of Examiners, 306 Transportation Building, Detroit.

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Routing for Super Highway In Chicago Region

The Chicago Regional Planning Association has made public for the first time a complete layout of a super highway system for the metropolitan area of 13 counties in Illinois, Wisconsin, and Indiana, in which it operates in a purely advisory capacity. Cost of the 340-mile system comprising ten radial routes and a belt line, with 160 to 200-ft. rights of way, is estimated at $80,000,000. Robert Kingery, secretary of the association and until recently director of the Illinois state department of public works, explained the system at the annual meeting of the association May 6, which was attended by state, county and city engineers and officials.

T. H. MacDonald, chief, U. S. Bureau of Public Roads, spoke on "The Roads of the Future" illustrating his talk with slides of European accomplishments. To attain a unified system centralized control of planning and priorities is essential, he stated.

D. H. Burnham was reelected president and Mr. Kingery, secretary of the association.

Tax on Idaho Contractors Based on Contract Size

Two bills recently enacted by the Idaho state legislature and now in effect provide for payment of a license tax of ½ percent of the total amount of every contract entered into with the state department of public works and require every contractor to sign an affidavit that his taxes in the state have been paid.

Payment of the license tax will be made to the Idaho commissioner of law enforcement, who will issue receipts which must be filed with the department of public works and be attached to the contract at the time of its execution. State income tax exemptions in the amount of the license taxes paid are allowed. The penalty for failure to pay this tax is cancellation of the contractor's right to the contract and forfeiture of his bidder's bond.

Qualified contractors are required to furnish satisfactory evidence that all accrued taxes (not including real property), excises, and license fees due to the state, its subdivision, and municipal and quasi-municipal corporations therein, have been paid. Taxes, accrued during the period of any contract, and payable at the end of such term, may be deducted from payment due the contractor on the pending contract.

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Waterworks Men Meet In Victoria, B. C.

Waterworks officials gathered in Victoria, B.C. May 20-22 for the tenth annual meeting of the Pacific Northwest Section of the American Water Works Association. About 140 members and guests from British Columbia and from western states attended.

Officers elected for 1937-38 are: chairman, M. H. McGuire, McMinnville, Ore.; vice-chairman, N. A. Gilman, Yakima, Wash.; secretary-treasurer, Fred Merryfield, Oregon State College, Corvallis, Ore.

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Goodrich to Advise on Canton Port Work

E. P. Goodrich, consulting engineer, New York, has been retained by the Whang Pao port administration of Canton, China, to advise on port and harbor development. To assist in the first stage of the improvement, the Chinese National Government has appropriated two million dollars; the work will include dredging and the construction of wharves. Tsang Yang Fu, vice-minister of railways, is mayor of Canton and head of the port administration.

OBITUARY

JOHN J. T. WITHINGTON, for 19 years water commissioner of Ashburnham, Mass., died in Gardner, Mass., May 27 at the age of 78.

CHARLES C. CULLEN, 69, who served on the engineering staff of the city of Louisville, Ky. from 1900 to 1935, died in that city, May 28.

JAMES S. MCILHENNY, 72, consulting engineer for the Washington Life Gas Line Co. of Washington, died in Birmingham, Ala., May 24.

JOHN H. STEHL, Baltimore structural engineer and for six years chief engineer of the building inspection bureau of that city, died there May 27.

JOHN W. MCEVOY, 72, who at the time of his resignation last March had served as superintendent of the Dubuque, Ia. water department for 16 years, died in that city recently.

ROBERT E. MASON, general manager of the Mason Construction Co., Louisville, Ky., roadbuilding firm, died in West Point, Ky., May 29, at the age of 60. He had superintended construction of much highway and railroad work and some dam construction in several of the southern states.

JOSEPH DRISCOLL, president and treasurer of the general contracting firm of James Driscoll & Son of Boston, Mass., died in Cambridge, Mass., May 26 at the age of 64. He was a graduate in 1896 of the Massachusetts Institute of Technology and served with the Boston Transit Commission for two years before joining the Driscoll Company.

RICHARD P. FARNSWORTH, 74, for many years a general contractor in New Orleans, died in that city on May 28. Mr. Farnsworth began his career as a bricklayer, afterwards contracting for jobs of varying sizes. He began business in New Orleans in 1919 as the builder of some of the buildings of the Marine Hospital group, later forming the firm of R. P. Farnsworth & Co. of which he was president at the time of his death.

COL. ERNEST H. RUFFNER, Corps of Engineers, retired, died in Cincinnati, May 27, at the age of 92. Col. Ruffner had planned and supervised construction of government highways in the Rocky Mountains and the Far West and had served as government lighthouse inspector and later as district engineer in Cincinnati. He was connected with engineering work on the Mississippi, Ohio, and the tributary rivers. He graduated from West Point in 1867.

CHRISTOPHER H. SNYDER, consulting structural engineer, San Francisco, died there May 28 at the age of 71. Mr. Snyder, a graduate of the University of Illinois, was widely known in the Bay region; he had been president of the San Francisco Engineers Club, the San Francisco Section of the A.S.C.E., the Pacific Association of Consulting Engineers and the Structural Engineers Association of Northern California. His early professional work was in the eastern states, principally with Milliken Bros. of New York City on structural design, but for the past 35 years he practiced in California.

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Dust Diseases Studied By Air Foundation

A plan of medical and engineering research to combat industrial diseases due to dust and fumes has been announced by the Air Hygiene Foundation, a non-profit scientific organization supported by 170 firms representing mining, metals, foundries, glass, refractories, ceramics and kindred industries.

The program calls for studies at Saranac Laboratory, Harvard School of Public Health, University of Pennsylvania Hospital, Singer Memorial Laboratory, and the Mellon Institute, and for work in cooperation with the U. S. Bureau of Mines. The researchers will seek to discover the basic elements involved in dust diseases such as silicosis; means for protection against the effects of gas; more practical information in the field of chest X-ray; means for reduction of the high pneumonia rate in smoky atmospheres.

The program is based on recommendations resulting from a survey to determine what remains to be known about occupational diseases.

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County Planning Progress In New York Area

In the Region of New York City, county planning is under way in ten counties, Essex, Fairfield, Middlesex, Morris, Passaic, Putnam, Rockland, Westchester, Union and Dutchess. All except Dutchess are using WPA staffs.

The Bergen County WPA project is now dormant pending approval of a supplementary project and allocation of funds. The Nassau County WPA project, revised to conform to changes brought about through adoption of the new county charter, has received preliminary approval and only awaits official action by the Board of Supervisors. The Hudson County mapping project has been re-submitted to Washington; Monmouth County Board of Freeholders has requested the District WPA office to put the county planning project in operation.

CONTRACT UNIT PRICES

What contractors are bidding on different kinds of construction work

SECTION 6, SIXTH AVENUE SUBWAY, NEW YORK

OWNER: Board of Transportation, City of New York.

PROJECT: Construction of the Sixth Avenue Subway from West Ninth St. to West Eighteenth St., Manhattan, N. Y., including the underpinning and maintenance of all structures and buildings enroute, and all labor and materials for the completed project exclusive of tracks, ties, ballast and station finish work. Station finish and equipment work are included however for the 14th St. station. The method of construction will be largely by trench excavation under cover, with a portion constructed by tunneling partly in normal air and partly in compressed air.

BIDS: Three proposals were opened May 11, 1937 and ranged from the low of $6,959,596 for steel lined tunnel (Proposition C) to a high of $9,424,678.

CONDITIONS: Contract is scheduled for completion within 36 months after contract award, with minimum hourly wage rates stipulated of $1.75 for skilled and 68¾ c. for common labor.

LOW BIDDERS: (based on Proposition C)

1. Spencer, White & Prentiss, New York, N. Y. $6,959,596
2. Del Balso Const. Co., New York, N. Y..... 7,881,071
3. Underpinning & Foundation Co., New York, N. Y..... 9,424,678

Item	Quan.	Unit Prices (1)	(2)	(3)
1. Earth excavation	111,000 c. y.	$10.00	$9.00	$11.00
2. Rock excavation	3,150 c. y.	20.00	15.00	20.00
3. Tunnel excavation	9,330 c. y.	50.00	35.00	45.00
4. Tunnel excavation, earth, comp	6,800 c. y.	60.00	40.00	50.00
5. Tunnel excav. rock	2,500 c. y.	60.00	45.00	75.00
6. Tunnel excav. air, earth, rock	5,250 c. y.	60.00	45.00	85.00
7. Steel sheet piling	41,300 s. f.	.50	2.00	5.00
8. Decking	10,800 s. y.	30.00	18.00	50.00
9. Tunnel timbering	65 M.b.m.	100.00	100.00	100.00
10. Steel supports	30 ton	100.00	100.00	100.00
11. Concrete masonry	25,000 c. y.	25.50	20.00	30.00
12. Protective concrete masonry	4,750 c. y.	25.00	20.00	40.00
13. Concrete finished surfaces	120,000 s. f.	.10	.12	.20
14. Hollow tile masonry	500 c. y.	50.00	30.00	50.00
15. Vitrified tile masonry	7,150 s. f.	1.00	1.00	.75
16. Non-slip tile treads	170 s. f.	2.50	3.00	3.00
17. Grout	1,500 bbl.	5.00	10.00	15.00
18. Pea gravel packing	750 c. y.	8.00	10.00	40.00
19. Structural steel	3,770 ton	150.00	130.00	150.00
20. Architectural steel, iron	11 ton	400.00	300.00	500.00
21. Steel bars, reinforcing	430 ton	125.00	100.00	140.00
22. Steel doors, sliding type "J"	50 s. f.	10.00	8.00	5.00
23. Misc. iron castings	26 ton	150.00	125.00	350.00
24. Wire mesh, reinforcements	11,300 lb.	.30	.20	.20
25. Expanded metal lath	20 s. y.	3.00	2.00	.75
26. One ply waterproofing	13,200 s. y.	1.50	.75	.50
27. Three ply waterproofing	10,700 s. y.	2.50	1.50	1.50
28. Four ply waterproofing	15,000 s. y.	3.50	2.00	2.00
29. Six ply waterproofing	100 s. y.	5.00	3.00	3.00
30. Dry ply	550 s. y.	1.00	.50	.40
31. One layer brick in mastic	1,000 c. y.	40.00	35.00	40.00
32. Asphalt mastic waterproofing	20 c. y.	40.00	35.00	40.00
33. Mop coat asphalt mastic	330 s. y.	1.00	.50	.40
34. Sheet copper water stops	1,500 s. f.	3.00	2.00	1.50
35. Concrete steel piles	470 l. f.	10.00	6.00	15.00
36. Fiber tunnel ducts, 2 in	40 l. f.	.75	.30	.40
37. Fiber tunnel ducts, 3 in	200 l. f.	1.00	.35	.40
38. Fiber tunnel ducts, 3½ in.	6,970 l. f.	1.25	.40	.50
39. Galv. steel cable pipe, 10 in	20 l. f.	10.00	10.00	50.00
40. Asbestos lumber panels, ¼ in	150 s. f.	1.50	1.00	2.00
41. Asbestos lumber panels, ½ in	75 s. f.	2.50	2.00	3.00
42. Cast iron pipe, 3 in	1,100 l. f.	2.00	2.00	.90
43. Cast iron pipe, 4 in	1,150 l. f.	2.25	2.25	1.20
44. Cast iron pipe, 6 in	170 l. f.	4.00	2.50	1.80
45. Cast iron pipe, 8 in	2,300 l. f.	5.00	3.00	2.40
46. Cast iron pipe, 10 in	80 l. f.	6.00	4.00	3.00
47. Cast iron pipe, 12 in	60 l. f.	10.00	5.00	3.60
48. Cast iron pipe, hvy. 3 in	200 l. f.	2.00	2.00	1.50
49. Cast iron pipe, hvy. 4 in	25 l. f.	3.00	2.25	2.00
50. Cast iron pipe, hvy. 6 in	50 l. f.	$4.00	$2.50	$3.00
51. Copper steel pipe, 3 in. cmt	300 l. f.	2.00	1.25	1.00
52. Copper steel pipe, 4 in. cmt	400 l. f.	3.00	1.50	1.50
53. Copper steel pipe, 8 in. cmt	300 l. f.	5.00	3.00	3.00
54. Std. galv. steel pipe	80 l. f.	5.00	3.00	3.00
55. T. C. flues 4½ x 13 in	30 l. f.	5.00	5.00	2.50
56. Vitrified drain pipe, 4 in	200 l. f.	1.00	1.00	1.50
57. Vitrified drain pipe, 6 in	130 l. f.	1.50	2.00	2.00
58. Copper tubing	200 l. f.	5.00	2.00	2.00
59. Basin connections, 12 in	600 l. f.	6.00	4.00	3.00
60. Basin connections, 15 in	740 l. f.	8.00	5.00	4.00
61. Flat top conc. sewer 3.5 x 2.3 ft	760 l. f.	25.00	15.00	30.00
62. Flat top conc. sewer 4.5 x 2.8 ft	120 l. f.	30.00	20.00	35.00
63. Flat top conc. sewer 3.5 x 3.16 ft	350 l. f.	25.00	20.00	30.00
64. Flat top conc. sewer 4 x 3.6 ft	380 l. f.	30.00	25.00	35.00
65. Flat top conc. sewer 4.5 x 4.08 ft	350 l. f.	35.00	30.00	40.00
66. House sewers to 8 in	200 l. f.	5.00	3.00	5.00
67. House sewers over 8 in	100 l. f.	10.00	4.00	6.00
68. Steel electric conduits, ¾ in	800 l. f.	.60	.50	.40
69. Steel electric conduits, 1 in	2,500 l. f.	.70	.60	.45
70. Steel electric conduits, 1¼ in	7,200 l. f.	.90	.70	.50
71. Steel electric conduits, 1½ in	50 l. f.	1.10	.80	.70
72. Steel electric conduits, 2 in	200 l. f.	1.20	1.00	.80
73. Steel electric conduits, 3½ in	970 l. f.	3.00	2.00	1.20
74. Steel electric conduits, 4 in	50 l. f.	4.00	2.50	1.30
75. C. I. Outlet boxes 4 x 4 x 3 in	1,100 each	2.30	2.00	1.00
76. C. I. Pull boxes 6 x 6 x 4 in	50 each	6.00	5.00	4.00
77. Steel gratings, frames	3,400 s. f.	4.00	2.00	3.00
78. Street asphalt restored	1,270 s. y.	5.00	3.00	3.50
79. Street granite surfacing	170 s. y.	10.00	6.00	3.50
80. Street surfacing within curbs	810 s. y.	4.00	2.50	5.00
81. Bluestone curb, 5 in	115 l. f.	5.00	2.00	3.00
82. Granite curb, 7 in	125 l. f.	6.00	3.00	4.00
83. Bluestone curb, 10 in	15 l. f.	10.00	4.00	6.00
84. Concrete curb	70 l. f.	3.00	1.50	3.00
85. Curb restored, bluestone	250 l. f.	4.00	1.50	2.00
86. Curb restored, granite	115 l. f.	5.00	1.50	2.50
87. Temp. roadway pavement	6,270 s. y.	5.00	2.00	3.00
88. Temp. sidewalk pavement	5,700 s. y.	4.00	2.00	3.00
89. Concrete finish, upper 3 in	250 s. y.	3.00	3.00	4.00
90. Lay l.p. water pipe, 6 in	500 l. f.	6.00	2.00	1.50
91. Lay l.p. water pipe, 12 in	470 l. f.	7.50	3.00	3.00
92. Lay h.p. water pipe, 8 in	75 l. f.	10.00	3.00	1.80
93. Lay h.p. water pipe, 12 in	280 l. f.	15.00	5.00	2.40
94. Lay h.p. water pipe, 16 in	135 l. f.	20.00	7.00	3.20
95. Lay h.p. water pipe, 24 in	205 l. f.	30.00	10.00	4.80
96. Lay steel gas pipe, 4 in	40 l. f.	2.00	2.00	1.00
97. Lay steel gas pipe, 6 in	570 l. f.	3.00	3.00	1.20
98. Lay steel gas pipe, 8 in	235 l. f.	5.00	4.00	1.60
99. Lay steel gas pipe, 10 in	80 l. f.	7.00	5.00	2.00
100. Lay steel gas pipe, 12 in	465 l. f.	8.00	6.00	2.40
101. Lay steel gas pipe, 16 in	300 l. f.	9.00	8.00	3.20
102. Lay steel gas pipe, 18 in	85 l. f.	10.00	10.00	3.60
103. Lay steel gas pipe, 20 in	3,520 l. f.	12.00	12.00	4.00
104. Lay steel gas pipe, 24 in	10 l. f.	15.00	14.00	5.00
105. Lay steel gas pipe, 30 in	225 l. f.	25.00	16.00	6.00
106. Steel gas pipe, 4 in	30 l. f.	.37	.37	.37
107. Steel gas pipe, 6 in	465 l. f.	.80	.80	.80
108. Steel gas pipe, 8 in	185 l. f.	1.17	1.17	1.17
109. Steel gas pipe, 10 in	80 l. f.	1.16	1.16	1.16
110. Steel gas pipe, 12 in	420 l. f.	1.84	1.84	1.84
111. Steel gas pipe, 16 in	290 l. f.	2.50	2.53	2.53
112. Steel gas pipe, 18 in	75 l. f.	2.72	2.72	2.72
113. Steel gas pipe, 20 in	460 l. f.	3.29	3.29	3.29
114. Steel gas pipe, 24 in	10 l. f.	4.34	4.34	4.34
115. Steel gas pipe, 30 in	225 l. f.	5.79	5.79	5.79
116. Dresser couplings, 6 in	37 each	2.43	2.43	2.43
117. Dresser couplings, 8 in	25 each	2.93	2.93	2.93
118. Dresser couplings, 10 in	7 each	3.52	3.52	3.52
119. Dresser couplings, 12 in	28 each	4.04	4.04	4.04
120. Dresser couplings, 16 in	20 each	6.02	6.02	6.02
121. Dresser couplings, 20 in	34 each	8.52	8.52	8.52
122. Dresser couplings, 30 in	16 each	22.93	22.93	22.93
123. Dresser red. couplings, 4 in	10 each	4.35	4.35	4.35
124. Dresser red. couplings, 6 in	28 each	5.55	5.55	5.55
125. Dresser red. couplings, 8 in	3 each	7.38	7.38	7.38
126. Dresser red. couplings, 12 in	6 each	14.41	14.41	14.41
127. Valves, 6 in	10 each	39.40	39.40	39.40
128. Valves, 8 in	2 each	53.91	53.91	53.91
129. Valves, 12 in	4 each	103.17	103.17	103.17
130. Valves, 20 in	10 each	234.86	234.86	234.86
131. Square valve boxes	14 each	10.29	10.29	10.29
132. Long valve boxes	14 each	12.46	12.46	12.46

(Additional Contract Unit Prices on second following page)